SMITE - A SECOND ORDER EULERIAN CODE FOR HYDRODYNAMIC AND ELASTIC-PLASTIC PROBLEMS

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USA BALLISTIC RESEARCH LABORATORIES
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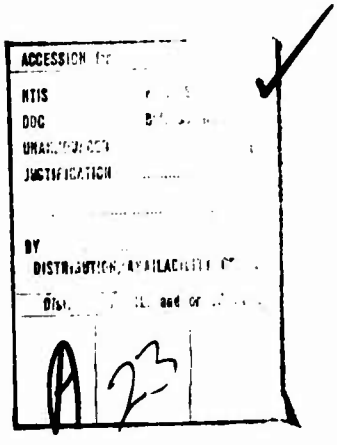

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A computer code for hydrodynamic and elastic-perfectly plastic problems is described. The model uses a second order finite difference method based upon a Eulerian formulation of the basic differential equations. The algorithm utilizes an individual grid for each material domain, determined by Lagrangian type boundary points which are subject to free surface and interface conditions. The only communication between domains is through their common interfaces.

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TABLE OF CONTENTS

I. INTRODUCTION

This manual describes the SMITE (Second order Moving Interface Two dimensional Eulerian) code for hydrodynamic and elastic-perfectly plastic problems. The code is based on an Eulerian formulation for the numerical model. Eulerian methods are characterized by a mesh which is fixed in space for all times. The materials are allowed to move freely through this grid. In the SMITE code, each material has its own independent grid. Thus, the mesh spacing and number of mesh grids in one material is in no way affected by that in another material. The equations are also solved in a transformed plane. This allows for transformations to be used which concentrate the mesh points in regions of greatest interest.

The extent of each domain is determined by particles or material points which define the domain boundary. These points are moved in a Lagrangian sense by integrating the ordinary differential equations relating their positions and velocities. The values at the boundary points are subject to free surface and interface conditions. The interface conditions provide the only communication between the various material domains.

The model upon which the SMITE code is based is fully described in the report "A Second Order Numerical Model for High Velocity Impact Phenomena" by the same authors. All references in this manual are to sections of the above report.

II. SUBROUTINE LOGIC

2.1 Main Program

The main program controls the overall logical flow of the code. INITAL is called to read input and initialize the run. All time increments are added to the starting time to determine when the processes dependent on these increments will next occur. The cycle count is incremented to start the main loop. The time step is set to the minimum of the CFL time step determined for all materials. If this time step is less than the minimum allowed, a message is printed and the run aborted. The time is incremented and MVBND called to move all material boundaries. ADJINT is then called to determine the new interface locations and adjust the boundary positions accordingly. Initial boundary values for each material are extrapolated from the interior by calling BONDRY. DENSB is then called to satisfy boundary conditions. The routine now loops through the material. GENVAL sets the proper material dependent mesh and array bound values. FDIFF is called next to solve the finite difference equations. FINISH is then called to determine if any shifting of the domain or rezoning of its boundary is necessary. The positions where the boundaries cross the mesh lines are determined by calling BPOSN and BVALU is called to calculate the crossing coordinates and the variable values at these crossing points. Values are then interpolated at all interior mesh points for which the finite difference equations could not be used by calling INTRPL. This ends the material loop. The error flag is checked and if it is set the run is aborted SECOND is called to obtain the elapsed running time. If the running time or problem time are greater than their maximum values, the run is ended. The problem time is compared to the time at which the next printer plot is desired. If this time has been exceeded PRNPLT is called and the printer plot increment is added to the printer plot time. The same is done with PLTOUT for plotter output, OUTPUT for printed output and SAVE for restart output. The next time cycle is then started. At the end of a run all desired output is generated regardless of the respective time increments.

2.2 ADJINT

Subroutine ADJINT determines the locations of material interfaces and adjusts boundary positions accordingly. In its present state, it is a rather ad hoc routine which makes strong assumptions regarding material orientation and relative position. If a particular problem does not meet these conditions, ADJINT will have to be modified or rewritten for that problem. It is assumed that all interfaces exist at the start of the problem. If the boundaries of the two materials penetrate each other, it is assumed that the first material (material A) that appears in the interface specification is the predominant material. The interface points of the second material (material B) will be replaced by those of material A. The task of ADJINT is to determine the exact extent of the interface. All boundaries consist of three segments which are divided by the boundary points into linear sub-segments. It is assumed that the interface starts with the first point of material A and the last point of material B and hence that material A is on the right of material B. In order to find the end of the interface, the logic is to find a point on each boundary not on the interface and then trace the boundaries toward the interface until they first intersect. It is further assumed that the interface lies entirely within the third segment of material B. The maximum z coordinate of material B

is found and then the last point of material A whose z coordinate is less than this maximum value. The next point on material A is the endpoint of the last material A sub-segment that can intersect the boundary of material B so that no additional points on the material A boundary are considered. The maximum r coordinate of the valid material A points is determined and then the first material B point less than this value. This point defines the endpoint of the first material B sub-segment than can intersect the boundary of material A. A box is drawn around the material B sub-segment and the first and last material A sub-segments that enter this box are determined. Only those sub-segments of material A between these end segments can possibly intersect the sub-segment of material B. Starting with the last material A sub-segment, each sub-segment is tested for an intersection. If an intersection is found then the lower sub-segment endpoints define the end of the respective interface segments. If an intersection is not found, a box is drawn around the next material B sub-segment and the search continues. Once an intersection is found, the material B interface segment is replaced by the material A interface segment. Since this replacement may add to the total number of material B boundary points a test is made to see if the number of points on the material B boundary exceeds the maximum allowable. If so, a message is printed and a flag is set to abort the run at the end of the cycle.

If material B represents material domain 3 special logic is provided. In this case, the interface segments as defined upon entering ADJINT are used. The points of the material B segment are simply replaced by the points of the material A segment. No assumptions are made about the segment location or boundary orientations.

2.3 BONDRY

This subroutine obtains values for all variables on the boundaries of the material domains. The boundary point coordinates, which upon entering BONDRY are in z-r space, are first transformed to α-β space. The arc length along the boundary at each point is then computed. Boundary values are extrapolated from the interior by choosing the closest interior mesh point to a boundary point and assigning the dependent variable values at this mesh point to the boundary point (5.a). The four mesh points surrounding a boundary point are examined. If the closest mesh point is interior to the domain it is chosen; if it is not interior. the next closest is selected, etc. If none of the four points are interior to the domain, the boundary point retains the values associated with it from the previous time step. These extrapolated values are then smoothed to prevent a step function appearance. The smoothing formula used is

$$b_i = a_i + \frac{1}{4} r \, (a_{i+1} - 2a_i + a_{i-1})$$

where r is the ratio of the time step used to the time step calculated for the material. This ratio prevents the smoothing operation from propagating signals through a material at a rate greater than the CFL stability condition would allow.

2.4 BPOSN

The positions where the boundaries cross the mesh lines are determined by subroutine BPOSN. Two similar arrays are defined, one for the mesh lines in each coordinate direction. These arrays are computed by systematically following the boundary. The logic for both sets is identical, so that only the computation of the crossings of the lines z=constant will be described. Let Int(a) be the largest integer less than or equal to a and Δz be the mesh spacing. Then $i=\text{Int}(z_m/\Delta z)$ implies that the boundary point p_m with axial coordinate z_m lies between mesh lines i and i+1. Starting with $n=\text{Int}(z_i/\Delta z)$ values of i are determined for succeeding boundary points until i is not equal to n. If i is less than n, mesh line n has been crossed; if i is greater than n, mesh line n+1 has been crossed. Let p_{m+1} be the boundary point where i changed value. Then the boundary crossed a mesh line between point m and m+1. The integer m is entered into the array for the mesh line that was crossed and all entries for that mesh line are ordered according to increasing radial coordinate values. A total of $|n-1|$ mesh lines may have been crossed and an entry is made for each of them. The integer n is then reset to $n=\text{Int}(z_{m+1}/\Delta z)$ and the procedure continues until the entire boundary has been traced.

2.5 BVALU

BVALU determines the coordinates of the points where the boundaries cross mesh lines and the values of the dependent variables at these points. The coordinates of a crossing are defined as the intersection of a mesh line with the straight line segment between the boundary points on either side of it. The dependent variable values are then obtained by interpolating along this line segment.

2.6 DENSB

Boundary conditions are satisfied by subroutine DENSB. INFACE is called to satisfy conditions on all interfaces. All non-interface, i.e free surface, points are then determined. The normal stress at these points is then set to zero (5.b).

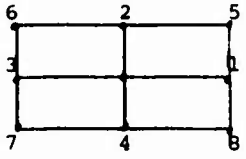
All interfaces are examined and an array is created which specifies, for each material, the first and last points of all boundary segments that are interfaces. These segment endpoints are arranged in ascending order with a zero after the last endpoint to signal the end of the array. Each material is then processed. The boundary coordinates are transformed from α-β to z-r space and the transformed values are stored in a temporary array. Each free surface segment, if any, will be all those boundary points lying between the high endpoint of one interface segment and the low endpoint of the next interface segment. The local slope at a point (z_i, r_i) is obtained from $\tan \psi = (z_{i+1}-z_{i-1})/(r_{i+1}-r_{i-1})$. For the normal stress to vanish, we must have

$$p = S_{11} \sin^2\psi + 2 S_{12} \sin \psi \cos \psi + S_{22} \cos^2\psi$$

This condition on pressure is satisfied by finding the internal energy and using Newton-Raphson iteration to solve the equation of state for the proper density. The density at the free surface boundary point is then set to this value. If the iteration does not converge, a message is printed and a flag is set to abort the run at the end of the cycle.

2.7 FDIFF

The finite difference equations at interior mesh points are evaluated in subroutine FDIFF (4.a). The entire mesh is shifted in memory two radial lines to the right (toward higher index of the axial mesh). It should be noted that the solution at any mesh point depends only on the mesh lines through that point and on either side of it. Hence, if the solution proceeds along radial mesh lines and the answers are stored back two lines to the left, only room for two additional mesh lines need be added to the memory arrays to allow the old solution to be overwritten by the new solution. The eight nearest neighbors of a mesh point are examined to determine if any lie outside the domain. The neighbors are ordered and if the nth neighbor is missing 2^{n-1} is added to a code word. The neighbors are ordered counterclockwise with the four nearest neighbors first starting with the right and then the four outer neighbors starting with the upper-right. If the code used is non zero, all neighbors are not interior to the domain and ONESTP is called. If all neighbors are present, the two



step solution may be used.

At each mesh point in the nine point solution lattice, the transformed seven component vector w and its vector functions f, g and h are computed and stored in 3x3 matrices. In both steps of the two step method, the difference equations for the first four components of w are evaluated first and then the difference equations for the three stress components are evaluated. Predicted values at the four midpoints of the boxes shown in the above figure are obtained. That portion of the second step which depends on values at time t is also obtained. The artificial viscosity is included in the partial second step evaluation.

The predicted values are used to define the f, g and h vectors at the lattice midpoint. The remainder of the second step of the solution that depends on the predicted values is then obtained. This solution is transformed back to its non-conservative form and stored in the solution array. A test is then made to determine if the stress components satisfy the yield condition. If they do not satisfy the yield criteria the stresses are modified to force them back on to the yield surface (3.b). Finally, the CFL stability parameter at the mesh point is evaluated. If the solution appears to be going unstable, ONESTP is called in an attempt to obtain a more stable value. After all mesh points have been evaluated, the L array is shifted back to it original locations. The CFL stable stepsize for the material is then computed.

2.8 FINISH

This subroutine checks the position of each domain relative to storage and of the boundary points of a domain relative to each other. As a domain moves through its mesh it may cover some mesh points and uncover others. The algorithm requires at least one line of exterior mesh points in all directions at the start of a time step. This ensures the existence of mesh points to allow the domain to expand in any direction. The boundary is checked to see if any point on it has exceeded the mesh. If the mesh is exceeded in one direction, the opposite direction is checked. If the opposite direction has more than two exterior mesh lines, the domain is shifted as far as possible in that direction. This is done by shifting all interior arrays in storage and performing a linear translation on the proper α-β coordinate. If a shift is not possible, a flag is set to abort the run at the end of the cycle. A message is printed together with the domain limits and the boundary coordinates in α-β space.

The arc length of each boundary segment is compared with the length of that segment when it first contained its present number of points. If the arc length more than doubled, the number of points is increased by fifty percent. All boundary points above the segment are shifted up to make room for the additional points. Tracer point and interface endpoint information that refers to the shifted boundary points is also adjusted. If the arcsize has not doubled the segment is also checked for relative distance between adjacent points. If the deviation from the average is too large the points in the segment are redistributed. The actual redistribution of points, whether the total number remain the same or has been increased, is performed by subroutine RELABL.

2.9 GENVAL

Values of various variables that depend on material properties and mesh geometry and which vary from one material domain to the next are set by subroutine GENVAL.

2.10 INFACE

The boundary conditions on interfaces are satisfied by subroutine INFACE. These conditions are the continuity of normal velocity and stress (S.C.). The local slope at a point (z_i,r_i) is obtained from $\tan \psi = (z_{i+1}-z_{i-1})/(r_{i+1}-r_{i-1})$. The boundary values obtained from the interior on each side of the interface are used to calculate a normal and tangential velocity and a normal stress. A weighted average of the normal velocities and another weighted average of the normal stresses are used to define a common normal velocity and a common normal stress. The common normal velocity together with the previously calculated tangential velocities on both sides of the interface are used to obtain the adjusted axial and radial velocities. The common normal stress provides a condition for pressure on both sides of the interface. Fixing the internal energy, a Newton-Raphson iteration is used to solve the equation of state for the proper density. If the iteration does not converge a message is printed and a flag is set to abort the run at the end of the cycle.

2.11 INITAL

All input data is read in subroutine INITAL. General run parameters are read first and the interfaces are defined. If the run is a continuation of a previous run, the interface parameters are overwritten by those on the restart tape. Input is then read for each material domain in turn. The domains are numbered according to the order in which they are input. The bounds of the array segments associated with the material are calculated and these segments are then zeroed out. Non-dimensionalization factors are then generated. Length is non-dimensionalized by mesh size so that the mesh size is unity. The scaling factor used for time is set to that for length so that velocity is non-dimensionalized by a speed of unity; hence non-dimensional velocity numerically remains the same as dimensional velocity. The initial material density is used to non-dimensionalize density. The constants needed in the coordinate transformations are calculated and the input boundary coordinates are transformed to α-β space. The transformed mesh size is unity for both coordinates so that the arc length of a boundary segment is an approximate measure of the number of mesh segments it traverses. Thus setting the number of points in each boundary segment to twice its arc length will result in approximately two boundary points per mesh segment. Values of r and its derivatives are calculated for each radial mesh point and mid-point. RELABL is called to generate the proper number of equally spaced boundary points from the input values. These points are then set to their initial values. The points where the boundary crossed the mesh lines and values at these points are determined by calling BPOSN and BVALU. The interior points are set to their initial values and IPOSN is called to determine which points are interior and which exterior to the domain. A line of reflected points below the axis of symmetry is then set. The CFL stepsize for the material is calculated as is the initial arc length of each boundary segment. If this run is a continuation of a previous run, the initial values are read from the restart tape. The restart domain is then shifted to the positions required by the first axial and radial mesh point interior to the domain as specified by the input. For a restarted problem those portions of INITAL that initialize domain values are skipped. After all materials have been input and initialized the time increments for the various types of output are examined. If the increment is negative it is set to a large number so that it will never be reached and its corresponding type of output will never occur. Otherwise the associated output subroutine is called to output the initial data.

2.12 INTRPL

The solution at mesh points that were too near to the domain boundary, that have just become interior to the domain or where the finite difference solution appeared to be going unstable is evaluated by interpolation from neighboring interior and boundary crossing points in subroutine INTRPL. First subroutine IPOSN is called to determine which points are interior to the domain. An axial mesh line below the axis of symmetry is reflected from the mesh line above the axis of symmetry. The mesh is then swept to determine which points remain to be computed by interpolation. Linear interpolation from adjacent interior or boundary crossing points is used. The four nearest neighbors to the mesh point are examined. Each may be a boundary crossing point, an interior point that was obtained from the finite difference equations or an in-

terior point that must be interpolated. These three possibilities at the four neighbors represent 81 possible configurations. Each configuration is accounted for and a point on either side of the mesh point is selected, if possible, for the interpolation process. Points that themselves must be interpolated are not selected since they may not as yet have been evaluated. After the entire mesh has been swept the points that were interpolated are redefined as normal interior points. A line of reflected values is again generated below the axis of symmetry to account for any recently interpolated values. The 81 possible configurations are represented by the codes in the following table. A 0 represents a boundary crossing point; a 1 represents an interior point that was obtained from the finite difference equations and a 2 represents an interior point that must be interpolated. Reading the numbers from right to left, the digits represent the point below, above, to the left and to the right of the mesh point. The points that were selected for use in the interpolation are underlined. In some cases only one point was used. Here the interpolated values were set directly to the values at that point.

1.	0000	22.	0210	42.	1112	62.	2021
2.	0001	23.	0211	43.	1120	63.	2022
3.	0002	24.	0212	44.	1121	64.	2100
4.	0010	25.	0220	45.	1122	65.	2101
5.	0011	26.	0221	46.	1200	66.	2102
6.	0012	27.	0222	47.	1201	67.	2110
7.	0020	28.	1000	48.	1202	68.	2111
8.	0021	29.	1001	49.	1210	69.	2112
9.	0022	30.	1002	50.	1211	70.	2120
10.	0100	31.	1010	51.	1212	71.	2121
11.	0101	32.	1011	52.	1220	72.	2122
12.	0102	33.	1012	53.	1221	73.	2200
13.	0110	34.	1020	54.	1222	74.	2201
14.	0111	35.	1021	55.	2000	75.	2202
15.	0112	36.	1022	56.	2001	76.	2210
16.	0120	37.	1100	57.	2002	77.	2211
17.	0121	38.	1101	58.	2010	78.	2212
18.	0122	39.	1102	59.	2011	79.	2220
19.	0200	40.	1110	60.	2012	80.	2221
20.	0201	41.	1111	61.	2020	81.	2222
21.	0202						

2.13 IPOSN

The L array, which specifies whether a mesh point is in a domain or not, is set in subroutine IPOSN. The crossing points of the boundary with the mesh lines are used to determine what is exterior and what is interior to the domain. The mesh is first swept along the lines r = constant. All mesh points along such a line up to the first boundary crossing are outside the domain. All points from the first crossing to the second crossing are inside. The next set of points are outside, then inside, etc. If a point is outside the domain, L is set to 0. If a mesh point is inside and L has been set to 2 because the point could not be calculated from the finite difference equations, it remains set at 2. Otherwise L is set to 2-L. Thus for all exterior points L is 0, for all interior points that were calculated from the finite difference equations L is 1 and for all interior points that have not yet been calculated L is 2. Interpolation errors in obtaining the boundary crossings may cause a mesh point to appear interior when one coordinate direction is considered, yet exterior when the other coordinate direction is considered. The algorithms require a mesh point to be interior no matter which coordinate direction is considered. To allow for this the boundary crossings of the mesh lines z = constant are also considered. The crossings are followed as before except that only exterior points need be considered. L is set to 0 for these points so that L will be non zero only for those mesh points which appear interior no matter which way the mesh is swept. For the z = constant mesh crossings the assumption that all mesh points until the first crossing are exterior is valid only if the lines are swept from above the domain toward the axis of symmetry.

2.14 MVBND

In this subroutine the domain boundaries are moved in time by using a simple Euler integration (5.a). The coordinates of the boundary points are transformed from α-β space to z-r space and the velocities are integrated with respect to time to find the new boundary positions. These new positions are then in the z-r coordinate system.

2.15 ONESTP

The one step finite difference equations for mesh points whose nine point solution stencil does not lie entirely in the domain are evaluated in subroutine ONESTP (4.b). As described in FDIFF, a code word is generated to specify which neighbors of the mesh point are missing. If this word is divided by 16 the result will refer to the four outer neighbors while the remainder refers to the four nearest neighbors. First derivatives and non mixed second derivatives may be approximated to second order by using the two points on either side of the mesh point in the required direction. These two points will be either mesh points or boundary crossing points. The four outer neighbors are required only for approximating the second mixed partial derivatives. Each of these outer points may be represented by a Taylor's series about the central mesh point. Combinations of these series will yield formulas for the mixed derivative in terms of the outer points and the first and non mixed second derivatives. Depending upon the combinations used, these formulas may be first or second order accurate. However, first order accuracy in the second space derivatives is all that is required for the overall difference scheme to remain second order accurate. By thus splitting the four outer neighbors from the four nearest neighbors the 256 possible combinations of missing points may be dealt with by first considering the 16 possibilities relating to the four nearest neighbors and then the 16 possibilities relating to the four outer neighbors.

The derivatives are evaluated first in the axial and then in the radial direction. In either case there are four possibilities to consider. There may be mesh points on both sides, a mesh point on either side and a boundary crossing on the opposite side or boundary crossings on both sides. When there is a boundary crossing, the distance to the boundary is calculated. If this distance is less than the allowable distance the point is skipped to be later evaluated by interpolation in subroutine INTRPL. After the derivatives in each direction are obtained the mixed derivatives are evaluated. These space derivatives are combined into the expressions appearing in the one step equations and these equations are computed. The artificial viscosity is then added. A test is made to determine if the stress components satisfy the yield condition. If they do not satisfy the yield criteria the stresses are modified to force them back onto the yield surface (3.b). Finally, the CFL stability parameter at the mesh point is evaluated. If the solution appears to be going unstable it is discarded to be later evaluated by interpolation in subroutine INTRPL.

The following table will illustrate the code used for missing points.

	Code	Date Used for Derivative Approximation
1.	0000	use all points
2.	0001	use lower right and lower left
3.	0010	use lower right and upper right
4.	0011	use lower right and lower left
5.	0100	use upper left and upper right
6.	0101	use lower right and upper left
7.	0110	use lower right and upper right
8.	0111	use lower right
9.	1000	use lower left and upper left
10.	1001	use lower left and upper left
11.	1010	use lower left and upper right
12.	1011	use lower left
13.	1100	use upper left and upper right
14.	1101	use upper left
15.	1110	use upper right
16.	1111	skip and interpolate

A 0 represents the presence of a point while a 1 means it is outside of the domain. The codes may represent the ordering of the 16 possibilities for both the four nearest neighbors and the four outer neighbors. Reading from right to left the digits represent, for the nearest neighbors, the points to the right, above, left and below. For the four outer neighbors the order is upper right, upper left, lower left and lower right. In representing the outer neighbors the codes are followed by an indication of which of the points are used in evaluating the mixed derivatives.

2.16 OUTPUT

This routine prepares all printed output. All output is of dimensioned variables and in z-r space. The output proceeds according to material domains. The boundary points appear first. If both IPRINT and JPRINT are not zero, the interior mesh points appear next. They are numbered along axial lines with the line nearest to the axis of symmetry first. Only those interior points which are also interior to a box of size IPRINT times JPRINT are printed. This box starts at the left boundary if IPRINT is positive or ends at the right boundary if IPRINT is negative. It starts at the bottom boundary if JPRINT is positive or ends at the top boundary is JPRINT is negative. The tracer particles are output next. Their values are obtained by interpolation from the proper boundary points. After all domains have been printed the boundary points that are interfaces are identified.

2.17 PLTOUT

Information is prepared in PLTOUT for processing by separate plot programs. The z-r space boundary coordinates, the tracer particle coordinates and the tracer particle velocities are calculated and then written out. All mesh points which are in a plastic region are then obtained. The coordinates of these points are then written out in blocks of 100 points.

2.18 PRNPLT

This subroutine prepares printer plots of the domain boundaries. The boundary points are transformed to z-r space and then scaled to inches of plot. The printer plot routine PRNT is then called for each point to plot the arrays.

2.19 PRS

PRS is a function subroutine to evaluate the equation of state. If the logical variable PDER is true it must also evaluate the partial derivatives of pressure with respect to density and internal energy. The routine supplied uses the Tillotson equation of state but may be replaced by any user written routine.

2.20 RELABL

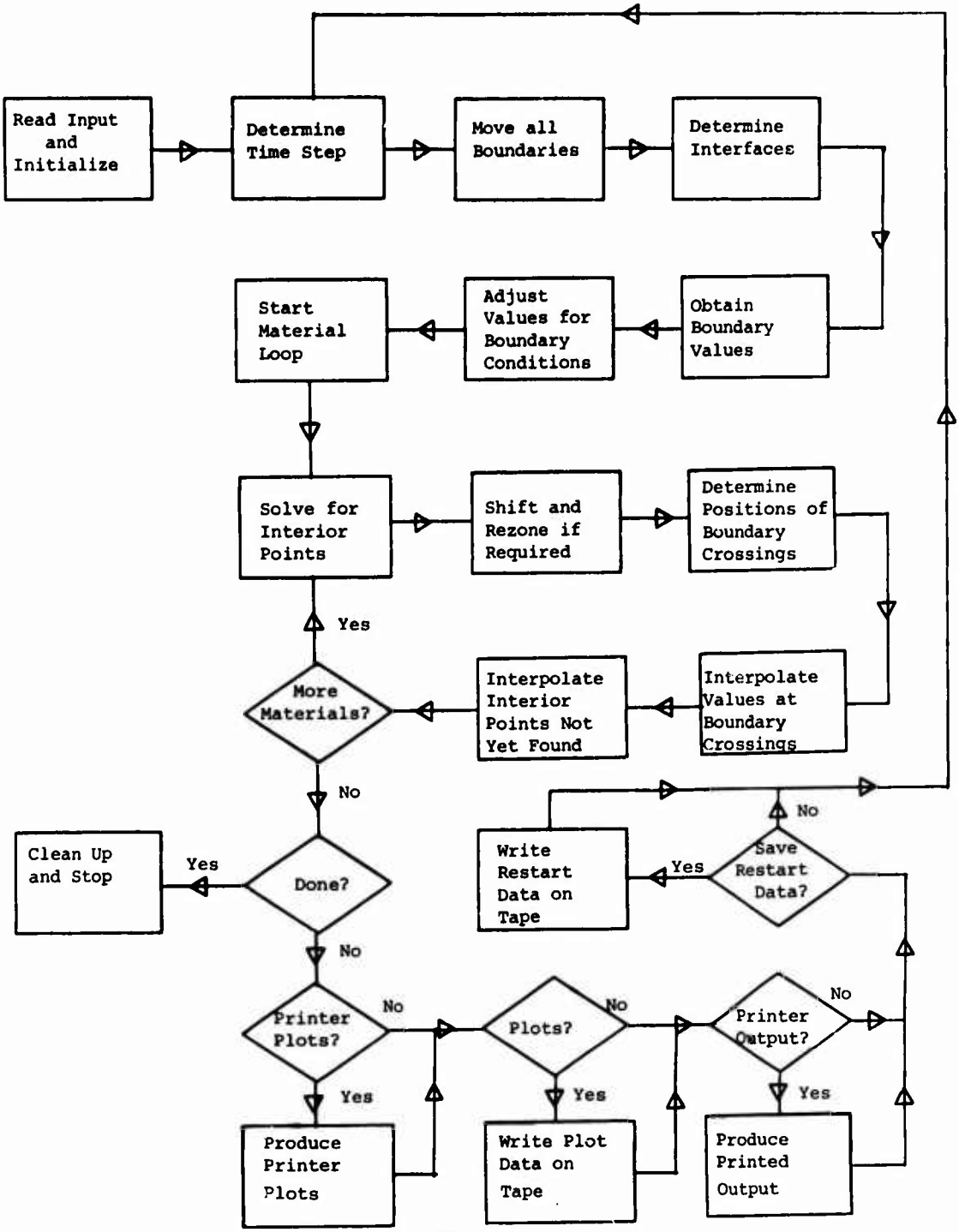
The points defining a boundary segment are redistributed over that segment in subroutine RELABL. The positions of tracer particles and interface end points are also redefined in relation to the new boundary points. The point coordinates and function values are considered to be functions of arc length along the boundary. The total arc length is divided into evenly spaced intervals by the number of points in the new set. At the end points of the evenly spaced intervals, new point coordinates and function values are interpolated from the old coordinates and values. The arc length value at a tracer particle is also used to find the exact new interval in which that particle lies and its relative position in that interval is then calculated. The new boundary points which define interface endpoints will be those points bounding the largest segment wholly contained in the old interface segment.

2.21 SAVE

Information needed to continue the calculation in a subsequent run is output by subroutine SAVE. Before being output, all domains are shifted as far to the left and bottom as possible. Only those mesh points interior to the smallest mesh rectangle containing the domain are then output. This allows for the possibility of the restarted problem being run using smaller arrays and less computer memory.

III. GENERAL PROGRAM DESCRIPTION

3.1 Flow Chart



3.2 Subroutine References

NAME	CALLED FROM	CALLS
MAIN PROGRAM		ADJINT, BONDRY, BPOSN, BVALU, DENSB, FDIFF, FINISH, GENVAL, INITAL, INTRPL, MVBND, OUTPUT, PLTOUT, PRNPLT, SAVE
ADJINT	MAIN	
BONDRY	MAIN	GENVAL
BPOSN	MAIN, INITAL	
BVALU	MAIN, INITAL	
DENSB	MAIN	GENVAL, INFACE, PRS
FDIFF	MAIN	ONESTP, PRS
FINISH	MAIN	RELABL
GENVAL	MAIN, BONDRY, DENSB, INITAL, MVBND, OUTPUT, PLTOUT	
INFACE	DENSB	PRS
INITAL	MAIN	BPOSN, BVALU, GENVAL, IPOSN, OUTPUT, PLTOUT, PRNPLT, PRS, RELABL
INTRPL	MAIN	IPOSN
IPOSN	INITAL, INTRPL	
MVBND	MAIN	GENVAL
ONESTP	FDIFF	PRS
OUTPUT	MAIN, INITAL	GENVAL, PRS
PLTOUT	MAIN, INITAL	
PRNPLT	MAIN, INITAL	
PRS	DENSB, FDIFF, INFACE INITAL, ONESTP, OUTPUT	
RELABL	FINISH, INITAL	
SAVE	MAIN	

3.3 Common Block References

NAME	REFERENCES
BLANK	BONDRY, FDIFF, FINISH, INITAL, INTRPL, IPOSN, ONESTP, OUTPUT, PLTOUT, SAVE
BNDERS	BONDRY, BPOSN, BVALU, FINISH, INITAL, INTRPL, IPOSN, ONESTP, OUTPUT
BNDVAL	ADJINT, BONDRY, BPOSN, BVALU, DENSB, FINISH, INFACE, INITAL, MVBND, OUTPUT, PLTOUT, PRNPLT, RELABL, SAVE
COMVAL	MAIN, ADJINT, BONDRY, BPOSN, BVALU, DENSB, FDIFF, FINISH, GENVAL, INFACE, INITAL, INTRPL, MVBND, ONESTP, OUTPUT, PLTOUT, PRNPLT, RELABL, SAVE
EPSTP	INITAL, PRS
INTFC	ADJINT, BONDRY, DENSB, FINISH, GENVAL, INFACE, INITAL, OUTPUT, RELABL, SAVE
MATARR	MAIN, ADJINT, BONDRY, BPOSN, DENSB, FDIFF, FINISH, GENVAL, INFACE, INITAL, MVBND, ONESTP, OUTPUT, PLTOUT, PRNPLT, RELABL, SAVE
MATVAL	BONDRY, BPOSN, BVALU, DENSB, FDIFF, FINISH, GENVAL, INITAL, INTRPL, IPOSN, MVBND, ONESTP, OUTPUT, PLTOUT, RELABL
MSHFCN	FDIFF, INITAL, ONESTP
PRESS	BONDRY, DENSB, FDIFF, GENVAL, INFACE, INITAL, ONESTP, OUTPUT, PRS
SCRTCH	ADJINT, BONDRY, DENSB, INFACE, INITAL, PLTOUT, PRNPLT, RELABL, SAVE
TRCPRT	BONDRY, FINISH, GENVAL, INITAL, OUTPUT, PLTOUT, RELABL, SAVE
TVALS	MAIN, INITAL, OUTPUT
ZONES	ADJINT, BONDRY, DENSB, FINISH, GENVAL, INFACE, INITAL, PLTOUT, PRNPLT, RELABL, SAVE

3.4 Storage Arrangement

The number of mesh points in each coordinate direction and the number of boundary points may vary from run to run and from material to material. In order to efficiently utilize computer memory the storage arrays have no fixed dimensions for these quantities. All materials are stored consecutively. The area reserved for each material is computed from input parameters. The index of any point in a material is computed relative to a reference value for that material. If KS is the reference value for a material then the point in that material with index K would be referred to in the array with index KS+K. The axial arrays are those in common BNDCRS whose name contains I and their reference is IS. The radial arrays are those in common BNDCRS whose name contains J and all arrays in common MSHFCN. The radial reference is JS. The first dimension of these arrays controls the maximum number of points for all materials and the second dimension controls the maximum number of boundary crossings in these directions. Thus, if IMAX and JMAX are the axial and radial dimensions, respectively, and for each material the maximum number of axial points is NI and the maximum number of radial points is NJ, then the requirement is

$$\Sigma NI \leq IMAX \qquad \Sigma(NJ+1) \leq JMAX$$

where the summation is over all materials. The addition of 1 to the NJ is to take account of the reflected line of data points below the axis of symmetry. The arrays for interior mesh points are in blank common and have reference IJS. A mesh point of axial index I and radial index J is referred to in the arrays with the single index IJS + (J-1)(NI+2) + I. If the array dimension is IJMAX then the requirement on the materials is

$$\Sigma(NI+2)(NJ+1) \leq IJMAX$$

The 2 that is added to NI allows for shifting as stated in the description of subroutine FDIFF. The boundary arrays are in common BNDVAL and have reference IBS. For dimensions BMAX and maximum per material of NB the storage requirement is again

$$\Sigma NB \leq BMAX$$

Temporary arrays for boundary points that are used separately for each material are in common SCRTCH. The storage requirement here is just that the maximum number of boundary points for any material be less than the array dimension. The maximum number of materials is the first dimension of the arrays in common ZONES, the second dimension in MATARR, the first dimension in TRCPRT and the second dimensions of the array NONIN in common INTFC. The maximum number of tracer particles per material is the second dimension of the arrays in common TRCPRT. The maximum number of interfaces is controlled by the array INFC in common INTFC which has six entries per interface while the maximum number of interfaces one material may have with all other materials is controlled by the first dimension of NONIN. NONIN must have storage for two entries per interface plus one additional entry to signal the last interface for the material.

3.5 Major Variables

NAME	COMMON	DEFINITION
A	MATVAL	Constant in β transformation
ABL	MATVAL	Constant in β transformation
AF	MATVAL	Constant in α transformation
AK	MATVAL	Time step (non-dimensional)
AKT	COMVAL	Total problem time
AL	MATVAL	$\Delta t/\Delta\alpha$
ALPH	EQSTP	α in Tillotson equation of state
ANG	MATVAL	Constant in α transformation
APB	EQSTP	A in Tillotson equation of state
APL	EQSTP	a in Tillotson equation of state
ARCSIZ	ZONES	Arcsize of boundary segments after adding points
AS	MATVAL	$\Delta t/\Delta\beta$
ASY	MSHFCN	α_r
ASYA	MSHFCN	$(\alpha_r)_\beta$ at $\beta + \frac{1}{2}\Delta\beta$
AX	MATVAL	α mesh spacing
AY	MATVAL	β mesh spacing
AYY	MSHFCN	$(\alpha_r)_\beta$
B	MATVAL	Constant in β transformation
BETA	EQSTP	β in Tillotson equation of state
BMAX	MATVAL	Constant in β transformation

NAME	COMMON	DEFINITION
BPB	EQSTP	B in Tillotson equation of state
BPL	EQSTP	b in Tillotson equation of state
CFL	MATVAL	Constant in stability equation
CHAN	MATVAL	Constant in inverse β transformation
DABL	MATVAL	Constant in inverse β transformation
DAL	COMVAL	Maximum deviation of distance between boundary points from average
DAX	MATVAL	$1/\Delta\alpha$
DAX2	MATVAL	$(1/\Delta\alpha)^2$
DAY	MATVAL	$1/\Delta\beta$
DAY2	MATVAL	$(1/\Delta\beta)^2$
DISMAX	ZONES	Maximum distance between points in boundary segments
DISMIN	ZONES	Minimum distance between points in boundary segments
DT	COMVAL	Time step (dimensional)
DTMIN	COMVAL	Minimum allowable time step
DTR	MATVAL	Ratio of time step to material time step
DY	MSHFCN	r_β/r
DYA	MSHFCN	r_β/r at $\beta + \frac{1}{2}\Delta\beta$
EIGF	MSHFCN	$(\alpha_r^2 + 1)^{1/2}$
EPS	COMVAL	Tolerance
EPSI	COMVAL	Tolerance
ERR	COMVAL	Error flag

NAME	COMMON	DEFINITION
ES	EQSTP	E_s in Tillotson equation of state
ESPRM	EQSTP	E_s' in Tillotson equation of state
ESY	MSHFCN	β_r
ESYA	MSHFCN	β_r at $\beta + \frac{1}{2}\Delta\beta$
ESYE	MSHFCN	$(\beta_r)_\beta$
EZERO	EQSTP	E_0 in Tillotson equation of state
FACT	MATVAL	Constant in α transformation
FMAT(1)	MATARR	α mesh spacing
FMAT(2)		β mesh spacing
FMAT(3)		Constant in stability equation
FMAT(4)		Onestep viscosity coefficient
FMAT(5)		Twostep viscosity coefficient
FMAT(6)		Shear modulus
FMAT(7)		Yield condition
FMAT(8)		Initial density
FMAT(9)		Length non-dimensionalizing factor
FMAT(10)		Pressure non-dimensionalizing factor
FMAT(11)		r origin in α-β coordinate system
FMAT(12)		z origin in α-β coordinate system
FMAT(13)		Constant in β transformation
FMAT(14)		Constant in β transformation

NAME	COMMON	DEFINITION
FMAT(15)		Constant in β transformation
FMAT(16)		Constant in inverse β transformation
FMAT(17)		Constant in inverse β transformation
FMAT(18)		Constant in β transformation
FMAT(19)		Constant in α transformation
FMAT(20)		Constant in α transformation
FMAT(21)		Constant in α transformation
FMAT(22)		Material time step
FMAT(23)		Ratio of time step to material time step
FRS	BNDVAL	Arcsize at boundary point
FRTDMU	MATVAL	$\frac{4}{3}\mu$
FRX	BNDVAL	z or α coordinate of boundary point
FRY	BNDVAL	r or β coordinate of boundary point
HAK	MATVAL	$\frac{1}{2}\Delta t$
HAL	MATVAL	$\frac{1}{2}\Delta t/\Delta\alpha$
HALFMU	MATVAL	$\frac{1}{2}\mu$
HAS	MATVAL	$\frac{1}{2}\Delta t/\Delta\beta$
HDAX	MATVAL	$1/(2\Delta\alpha)$
HDAXY	MATVAL	$1/(2\Delta\alpha\cdot\Delta\beta)$
HDAY	MATVAL	$1/(2\Delta\beta)$

NAME	COMMON	DEFINITION
IBS	MATVAL	Material reference in boundary arrays
IJS	MATVAL	Material reference in two-dimensional arrays
IMAT(1)	MATARR	Maximum number of axial mesh points
IMAT(2)		Maximum number of radial mesh points
IMAT(3)		Maximum number of boundary points
IMAT(4)		Material reference in axial arrays
IMAT(5)		Material reference in radial arrays
IMAT(6)		Material reference in two-dimensional arrays
IMAT(7)		Material reference in boundary arrays
IMAT(8)		Axial index of mesh point leading to minimum step size
IMAT(9)		Radial index of mesh point leading to minimum step size
IMAT(10)		Material property index
IMAT(11)		Maximum lines printed in axial direction
IMAT(12)		Maximum lines printed in radial direction
IND	BNDCRS	Indicator of boundary crossings with constant α mesh line
INFC	INTFC	Interface definitions
IS	MATVAL	Material reference in axial arrays
ISB	MATVAL	Axial index of mesh point leading to minimum step size
ISTART	TVALS	Restart flag
ITR	TRC RT	Index of boundary segment containing tracer particle
JND	BNDCRS	Indicator of boundary crossings with constant β mesh line

NAME	COMMON	DEFINITION
JS	MATVAL	Material reference in radial arrays
JSB	MATVAL	Radial index of mesh point leading to minimum step size
KMAX	COMVAL	Number of equations
KT	COMVAL	Cycle count
L	BLANK	Interior mesh point flag
LB	COMVAL	Start of boundary segment to be rezoned
LF	COMVAL	End of boundary segment to be rezoned
MAT	MATARR	Material index
MATNO	PRESS	Material property index
MU	MATVAL	Shear modulus
NBEG	ZONES	Index of first point of boundary segment
ND	MATVAL	Index of last point of first boundary segment
ND1	MATVAL	ND+1
NE	MATVAL	Index of last point of second boundary segment
NEIBR	COMVAL	Code word describing intersection of boundary and nine point lattice
NEND	ZONES	Index of last point of boundary segment
NE1	MATVAL	NE+1
NF	MATVAL	Index of last point of boundary
NFMAX	MATVAL	Maximum number of boundary points
NI	MATVAL	Maximum number of axial mesh points

NAME	COMMON	DEFINITION
NIM1	MATVAL	NI-1
NINFC	INTFC	Number of material interfaces
NIP2	MATVAL	NI+2
NJ	MATVAL	Maximum number of radial mesh points
NJM1	MATVAL	NJ-1
NMAT	MATARR	Number of materials
NONIN	INTFC	Array of interface endpoints for each material
NTR	MATVAL	Number of tracer particles
NTRS	TRCPRT	Number of tracer particles array
OOVMU	MATVAL	$1/\mu$
PBI	BNDCRS	Radial coordinate of intersection of boundary and line z=constant
PBJ	BNDCRS	Axial coordinate of intersection of boundary and line r=constant
PDER	PRESS	Flag for computing pressure derivatives
PE	PRESS	Derivative of pressure with respect to energy
PMIN	EQSTP	Minimum pressure
PORG	COMVAL	Value in centimeters corresponding to start of printer plot
PR	PRESS	Derivative of pressure with respect to density
PSCL	COMVAL	Scale of printer plot in centimeters per inch
PO	MATVAL	Pressure non-dimensionalizing factor
QAK	MATVAL	$\frac{1}{4}\Delta t$
QAL	MATVAL	$\frac{1}{4}\Delta t/\Delta\alpha$

NAME	COMMON	DEFINITION
QAS	MATVAL	$\frac{1}{4}\,\Delta t/\Delta\beta$
QDAXY	MATVAL	$1/(4\Delta\alpha\cdot\Delta\beta)$
RDIS	COMVAL	Minimum fractional mesh allowed in onestep equations
RHOZRO	EQSTP	Initial density array in equation of state
RHO	MATVAL	Initial density
SBM	MATVAL	CFL stability parameter
TCOMP	TVALS	Maximum computation time in seconds
TFRX	SCRTCH	Scratch array for axial boundary points
TFRY	SCRTCH	Scratch array for radial boundary points
TMAX	TVALS	Maximum problem time in microseconds
TOP	COMVAL	$2/\pi$
TPLOT	TVALS	Plot tape output increment
TPRIN	TVALS	Printed output increment
TPRPL	TVALS	Printer plot increment
TREOTM	MATVAL	$3/(2\mu)$
TRS	TRCPRT	Relative position of tracer particle in boundary segment
TSAVE	TVALS	Save tape output increment
TWB	SCRTCH	Scratch array for dependent variables on boundary
TWTDMU	MATVAL	$2\mu/3$

NAME	COMMON	DEFINITION
TZ	TVALS	Real computation time at start of first cycle
TO	MATVAL	r origin in α-β coordinate system
VIS	MATVAL	Onestep viscosity coefficient
VIST	MATVAL	Twostep viscosity coefficient
W	BLANK	Array of dependent variables
WB	BNDVAL	Array of dependent variables on boundary
WBI	BNDCRS	Dependent variables at intersection of boundary and line z=constant
WBJ	BNDCRS	Dependent variables at intersection of boundary and line r=constant
XZ	MATVAL	z origin in α-β coordinate system
XO	MATVAL	Length non-dimensionalizing factor
Y	MSHFCN	$r(\beta)$
YC	MATVAL	Yield condition
YSE	MSHFCN	r_{β}
YSEA	MSHFCN	r_{β} at $\beta + \frac{1}{2}\Delta\beta$

IV. PROGRAM USAGE

4.1 Input

There are three types of input data, integer (I), real (R) and alphanumeric (A). An integer is a number without a decimal point which must be right justified in its field. A real number has a decimal point which may be followed by an exponent of the form E±N. The ±N represents the power of 10 by which the number is to be multiplied. The + may be omitted if N is positive and the E need not appear if either the + or - is present. If an exponent is present it must be right justified in the field. Alphanumeric input consists of exactly the punched characters and blanks appearing in the field. A description of the necessary input data for SMITE follows. The card number refers to the type of input. If more than one card is necessary for this input, there may be several cards of the same type number. A number in parenthesis indicates an optional card.

CARD	COLS.	TYPE	NAME	DESCRIPTION
1	1-80	A	TITLE	Any alphanumeric information to be printed at the beginning of the output
2	1-10	R	TMAX	Maximum problem time in microseconds
	11-20	R	TPRIN	Print output increment in microseconds
	21-30	R	TPRPL	Printer plot output increment in microseconds
	31-40	R	TPLOT	Plot tape output increment in microseconds
	41-50	R	TSAVE	Restart tape output increment in microseconds. If any output increment is negative that output is suppressed
	51-60	R	TCOMP	Maximum computation time in seconds
	61-70	R	PORG	Value in centimeters of axial coordinate at left center of printer plot. The radial coordinate is set to zero
	71-80	R	PSCL	Scale of printer plot in centimeters per inch.
3	1-10	R	RDIS	Minimum fractional mesh allowed in onestep equations. If a point is closer to the boundary than this fraction of mesh size, interpolation will be used.
4	1-5	I	NMAT	Number of materials.
	6-10	I	ISTART	Restart flag. Zero for initial run, otherwise non zero.
5	1-5	I	NINFC	Number of material interfaces
6	1-5	I	INFC(1)	Index of dominant material of interface. Boundary of this material defines interface.
	6-10	I	INFC(2)	Index of first boundary point on interface.
	11-15	I	INFC(3)	Index of last boundary point on interface.
	16-20	I	INFC(4)	Index of second material of interface. Interface boundary of this material replaced by interface boundary of first material.
	21-25	I	INFC(5)	Index of last boundary point on interface.
	26-30	I	INFC(6)	Index of first boundary point on interface.
	31-35	I	INFC(7)	Index of dominant material of next interface, etc.
	36-40	I	INFC(8)	
	41-45	I	INFC(9)	This sequence is repeated, six entries per interface, two interfaces per card
	46-50	I	INFC(10)	until all interfaces have been defined. The boundary point indices refer to
	51-55	I	INFC(11)	the points defining the material boundaries in the order in which they are input
	56-60	I	INFC(12)	with the repeated points neglected.

CARD	COLS.	TYPE	NAME	DESCRIPTION
				The set of cards containing the input parameters for the individual materials follows. This entire set is repeated for each material until all materials have been defined.
7	1-5	I	NI	Maximum number of mesh lines allowed in axial direction.
	6-10	I	NJ	Maximum number of mesh lines allowed in radial direction.
	11-15	I	IF	First axial index interior to domain.
	16-20	I	IL	Last axial index interior to domain.
	21-25	I	JF	First radial index interior to domain. Must be 1 if domain touches axis and greater than 1 otherwise.
	26-30	I	JL	Last radial index interior to domain. At least one mesh line must be exterior to the material on all sides (except at axis). Additional exterior mesh lines should be allowed in the directions that the material will move. If the material reaches the end of the allowed mesh in one direction and there is exterior mesh in the opposite direction, it will be automatically shifted.
	31-35	I	NLF	Number of points in first boundary segment.
	36-40	I	NTP	Number of points in second boundary segment.
	41-45	I	NRT	Number of points in third boundary segment.
	46-50	I	NFMAX	Maximum number of boundary points allowed.
	51-55	I	NTR	Number of tracer particles.
	56-60	I	MATNO	Material property number. If positive equation of state constants set in program, if negative they are input.
	61-65	I	IPRINT	Maximum number of interior points printed in axial direction. If positive count from leftmost interior point, if negative count from rightmost interior point.
	66-70	I	JPRINT	Maximum number of interior points printed in radial direction. If positive count from lowest interior point, if negative count from highest interior point. If either IPRINT or JPRINT is zero no interior points will be printed.
8	1-10	R	ZLEN	Initial axial length in centimeters.
	11-20	R	YMAX	Initial radial length in centimeters.
	21-30	R	THETA	89.5
	31-40	R	CAP	1.0E4
	41-50	R	D	Radial length of densest mesh spacing. Radial mesh will be fairly uniform for this length and will then increase in size.
	51-60	R	VIS	Viscosity coefficient for onestep equations] These coefficients should be
	61-70	R	VIST	Viscosity coefficient for twostep equations! between zero and two.
	71-80	R	CFL	Fraction of computed time step used. A safety factor usually between 0.5 and 0.8.
9	1-10	R	MU	Shear modulus in 10^{12} dynes/cm^2.
	11-20	R	YC	Yield strength in tension in 10^{12} dynes/cm^2 .
	21-30	R	RHO	Initial density in grams/cm^3.
	31-40	R	UI	Initial axial velocity in centimeters/microsecond .

CARD	COLS.	TYPE	NAME	DESCRIPTION
				The following card is optional to input the Tillotson equation of state parameters.
10	1-10	R	APL	a
	11-20	R	BPL	b
	21-30	R	APB	A in 10^{12} dynes/cm^2
	31-40	R	BPB	B in 10^{12} dynes/cm^2
	41-50	R	ALPH	α
	51-60	R	BETA	β
	61-70	R	ES	E_s in 10^{12} ergs/gm
	71-80	R	EZERO	E_o in 10^{12} ergs/gm
10a	1-10	R	ESPRM	E_s' in 10^{12} ergs/gm
	11-20	R	PMIN	Minimum allowable pressure in 10^{12} dynes/cm^2
11	1-10	R	FRX(I)	Axial coordinate in centimeters of first point of first boundary segment.
	11-20	R	FRY(I)	Radial coordinate in centimeters of first point of first boundary segment.
	21-30	R	FRX(I)	Axial coordinate of second point.
	31-40	R	FRY(I)	Radial coordinate of second point.
	41-50	R	FRX(I)	
	51-60	R	FRY(I)	This sequence is repeated, four points per card, until the entire segment
	61-70	R	FRX(I)	has been input.
	71-80	R	FRY(I)	
12	1-10	R	FRX(I)	Axial coordinate in centimeters of first point of second boundary segment.
	11-20	R	FRY(I)	Radial coordinate in centimeters of first point of second boundary segment.
	21-30	R	FRX(I)	
	31-40	R	FRY(I)	This sequence is repeated, four points per card, until the entire segment
	41-50	R	FRX(I)	has been input.
	51-60	R	FRY(I)	The first point of this segment should repeat the last point of the first
	61-70	R	FRX(I)	segment and the last point should agree with the first point of the third
	71-80	R	FRY(I)	segment.
13	1-10	R	FRX(I)	Axial coordinate in centimeters of first point of third boundary segment.
	11-20	R	FRY(I)	Radial coordinate in centimeters of first point of third boundary segment.
	21-30	R	FRX(I)	
	31-40	R	FRY(I)	This sequence is repeated, four points per card, until the entire segment has
	41-50	R	FRX(I)	been input. If the boundary touches the axis of symmetry, the defining points
	51-60	R	FRY(I)	must start and end on the axis of symmetry. If the boundary does not touch the
	61-70	R	FRX(I)	axis, the first and last points should be the same and should be on a part of
	71-80	R	FRY(I)	the boundary that will never become a material interface.

CARD	COLS.	TYPE	NAME	DESCRIPTION
14	1-5	I	ITR	Index of first boundary point selected as tracer.
	6-10	I	ITR	Index of second boundary point selected.
	11-15	I		
	16-20	I		This sequence is repeated, sixteen indices per card until all tracer
	21-25	I		particles are selected. The boundary point indices refer to the points
	25-30	I		defining the material boundary in the order in which they are input
	31-35	I		with the repeated points neglected. These tracer points will be tagged
	36-40	I		with their input number on this card and their position in time will be
	41-45	I		traced throughout the run.
	46-50	I		
	51-55	I		
	56-60	I		
	61-65	I		
	66-70	I		
	71-75	I		
	76-80	I		

4.2 Sample Input

Complete listings of the input decks for the two Silver Bullet computations (without and with a sheath) (6.0) appear on the following pages. In addition, listings of sample input decks for the following five geometric and material combinations are given. These five cases have not actually been run. They are presented only as illustrations of various possible input configurations.

Case 1. A blunt truncated mild steel rod (1020) impacting a 0.635 cm (1/4") aluminum target at a striking velocity of .371 km/sec (1220 ft/sec).

Case 2. A Bearcat rod with a hemispherical nose impacting a 1.27 cm (1/2") aluminum target at a striking velocity of .343 km/sec (1125 ft/sec).

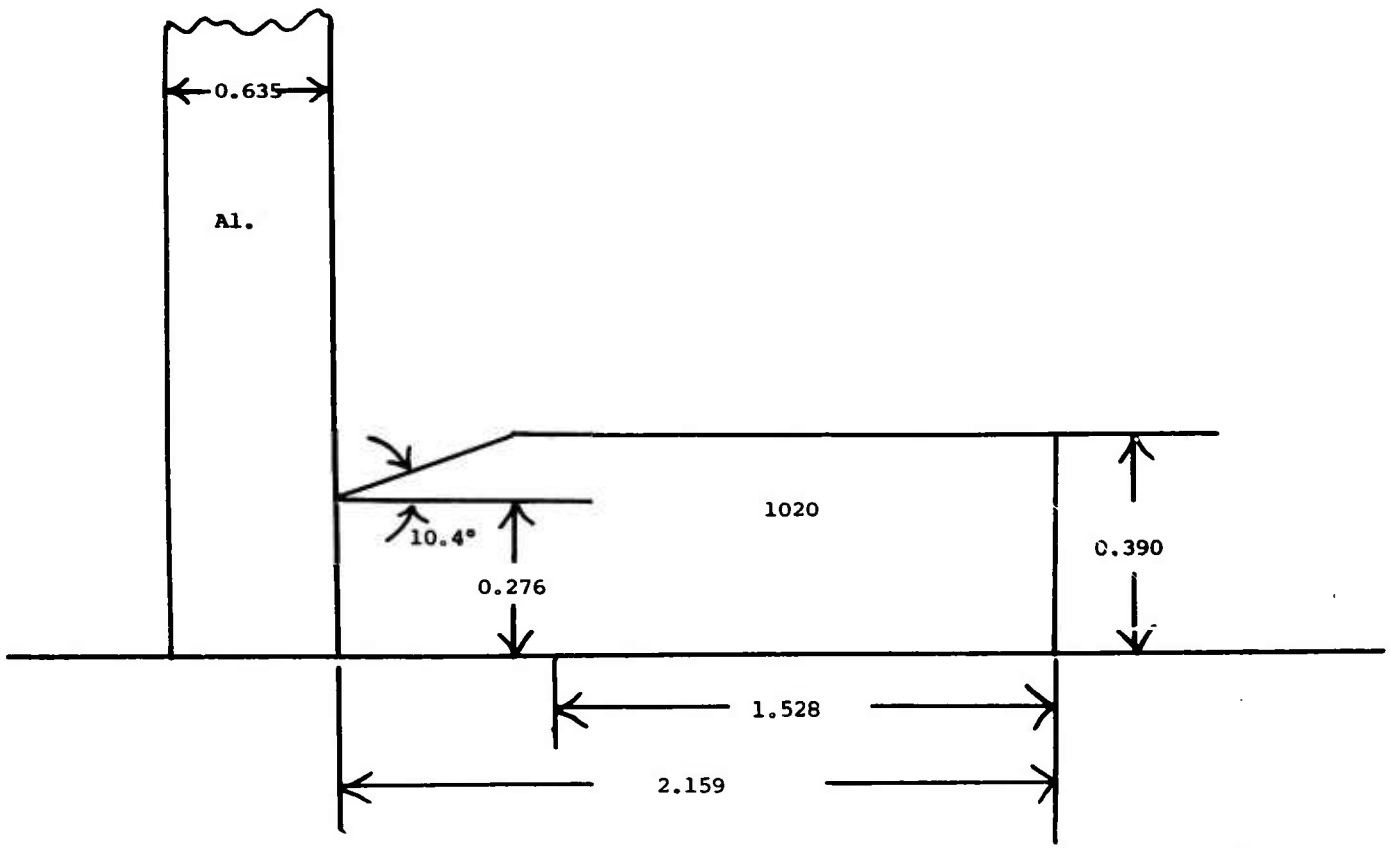
Case 3. A hollow Bearcat cylinder impacting a 1.905 cm (3/4" aluminum target at a striking velocity of 1.22 km/sec (4000 ft/sec).

Case 4. An ogival projectile with an aluminum core and a tungsten carbide sheath impacting a 2.54 cm (1") target of rolled homogeneous armor at a striking velocity of 1.372 km/sec (4500 ft/sec).

Case 5. A hemispherical cap projectile with a tungsten alloy core and a maraging-300 steel sheath impacting a .9525 cm (3/8") target of rolled homogeneous armor at a striking velocity of 1.524 km/sec (5000 ft/sec).

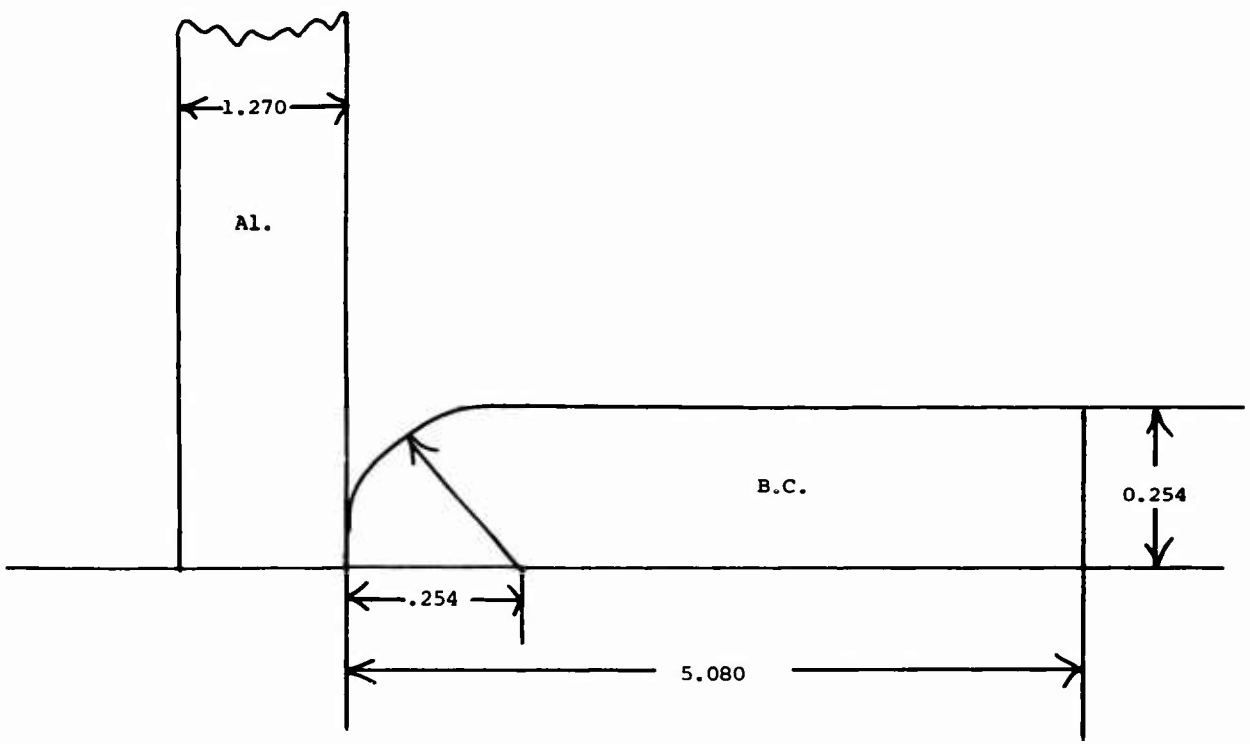
Target-projectile configurations are shown for each case. Sketches are not to scale and all dimensions are in centimeters.

CASE #1



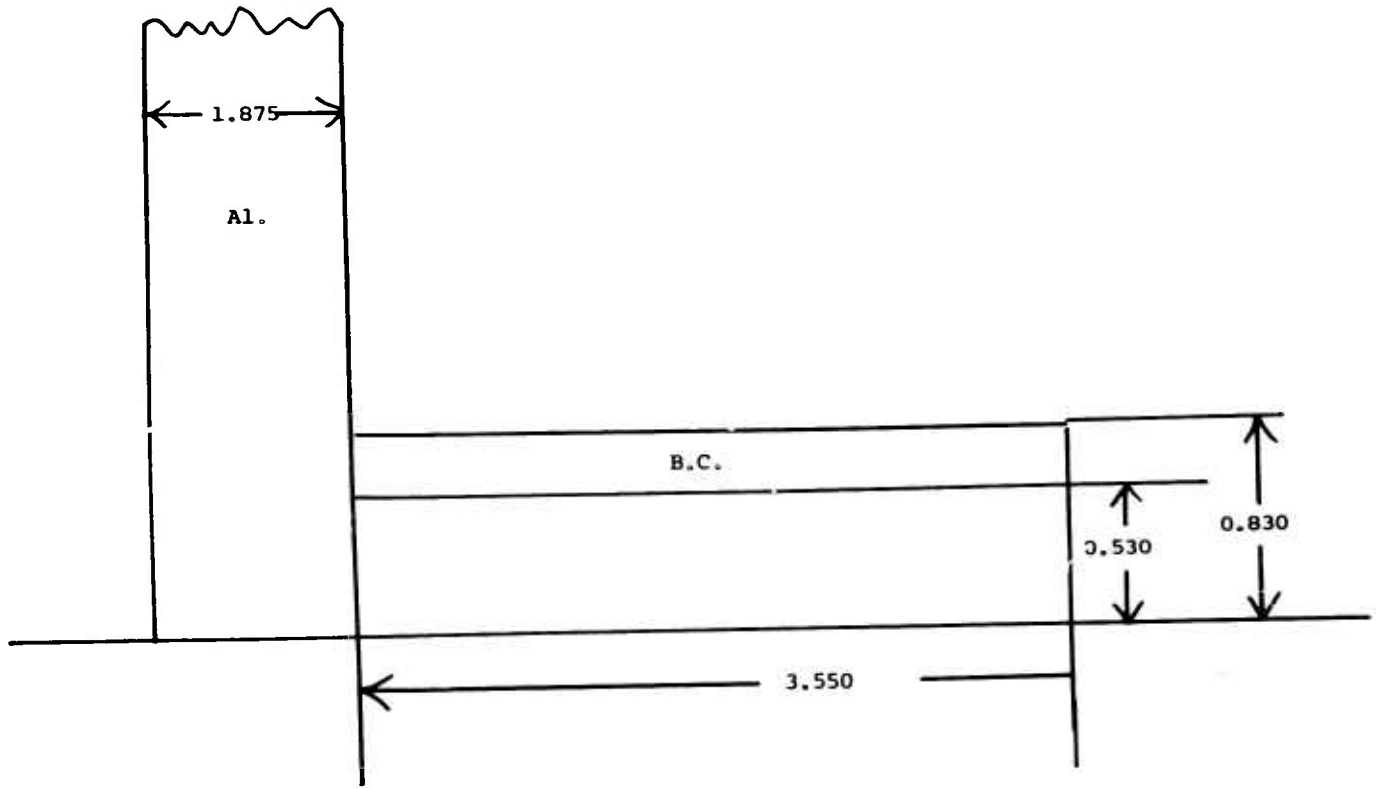
Dimension: cm.

CASE #2



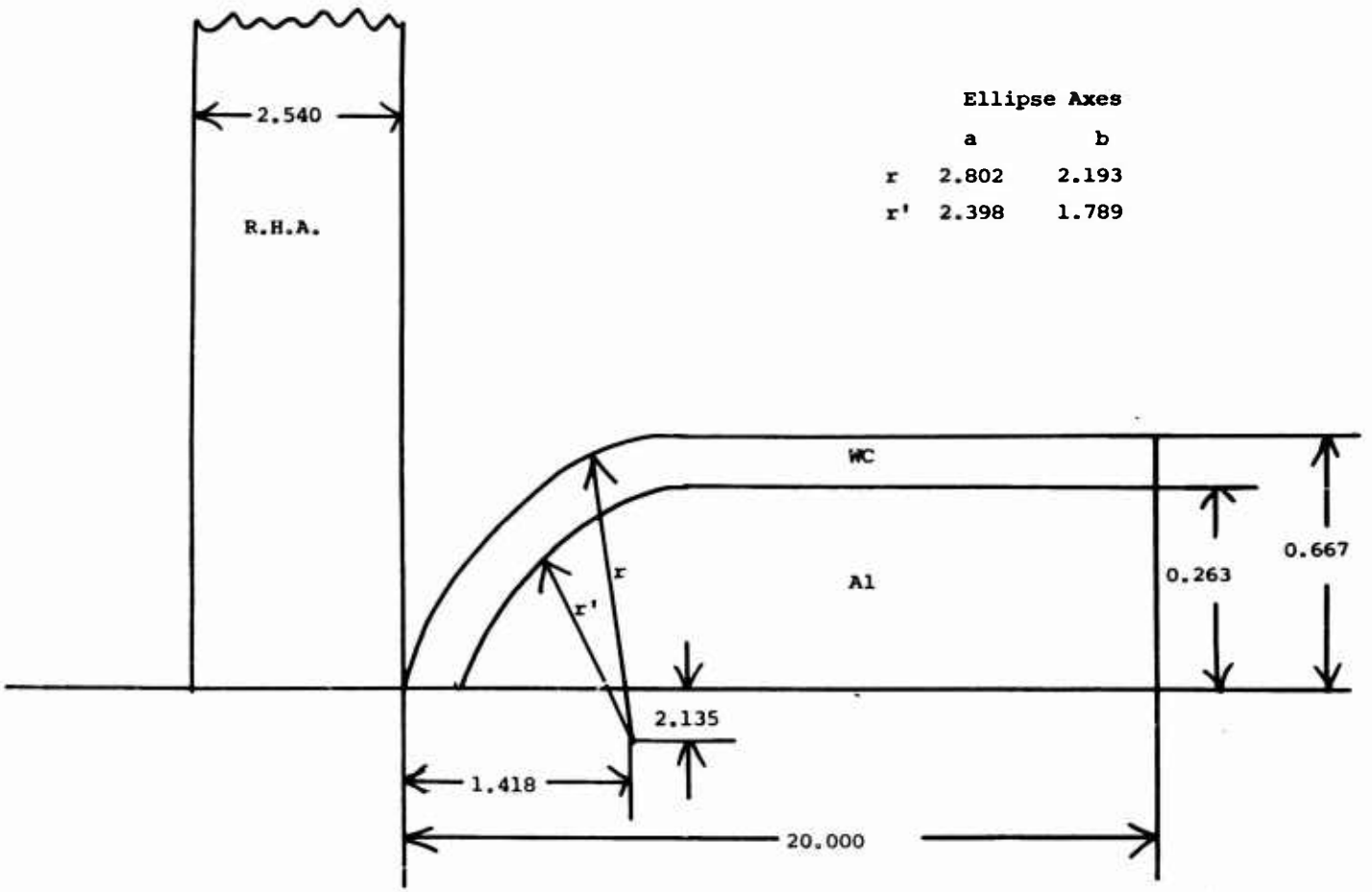
Dimension: cm.

CASE #3



Dimension: cm.

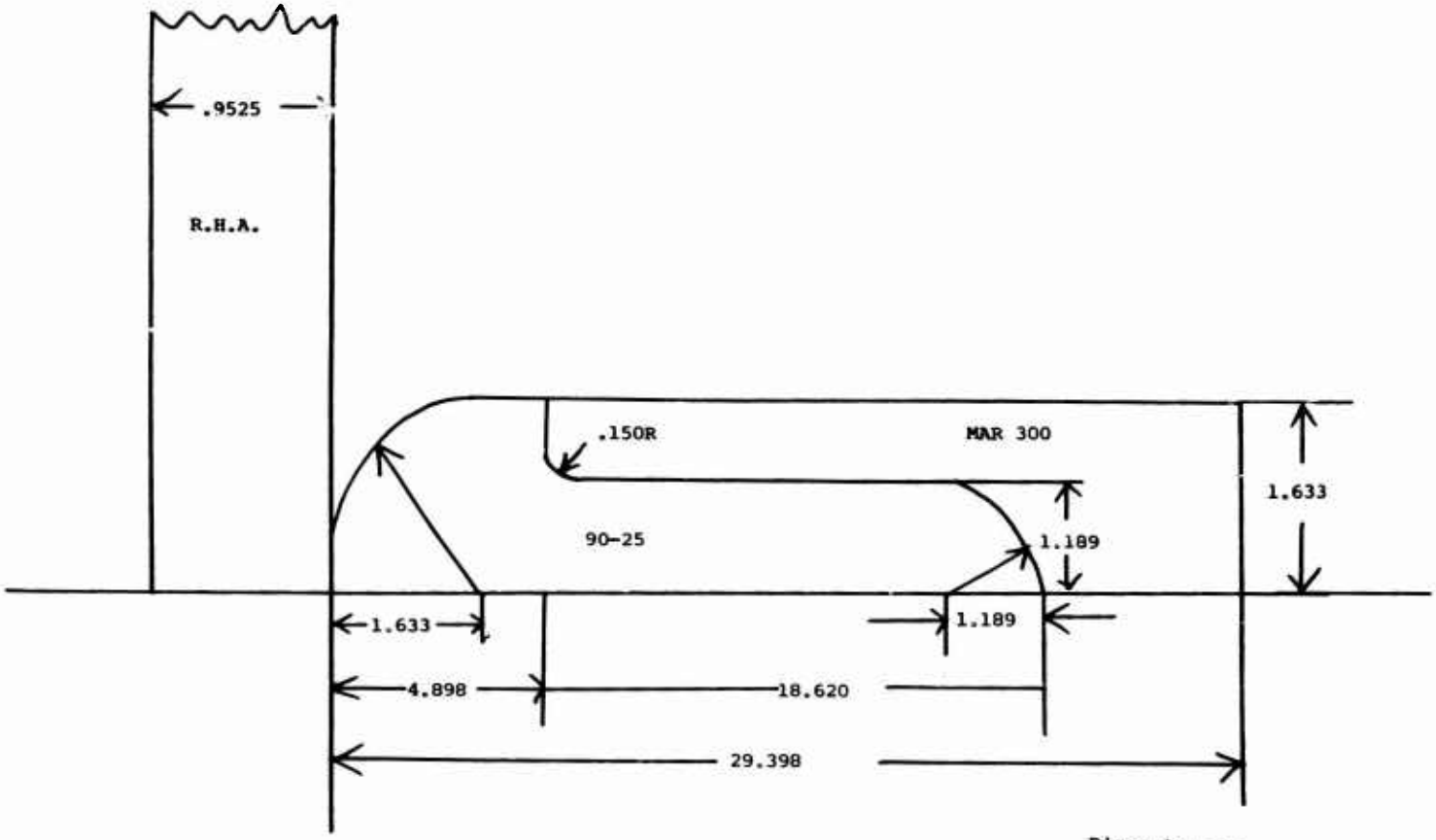
CASE #4



	Ellipse Axes	
	a	b
r	2.802	2.193
r'	2.398	1.789

Dimension: cm.

CASE #5



Dimension: cm.

```
 SILVER BULLET-NO SHEATH
35,00        5.0          5,0          5,0          5,0          2500.0       =5.0         5,0
0,5
     2     0
     1
     2     1     1     1     6     6
    31    25    16    25     1    24     3              3   300     3     1    50    11
2.54          9,0          89,5         1000.0       0,5          1,8          1.8          0,65
0.8077        0,01219      7,80         0.0
0.0           0,0          0,0          1,75         0,0          9,0
0.0           9,0          2,54         9,0
2.54          9,0          2,54         1,75         2,54         0,0
     1     2     5
   121    20    21   120     1    17    10    20     2   300    16     2    20    20
40,82         1,75         89,5         1000.0       1,75         1,8          1.8          0,65
1.2967        0,0111       17,04        =0,142
 2,5400000 0.0000000 2,6502360  .4805076 2,7604720  .6614160 2,8707080  .7872425
 2,9809440  .8818880 3,0911800  .9546718 3,2014160 1,0103296 3,3116520 1,0515844
 3,4218880 1,0800878 3,5321240 1,0968344
 3,5321240 1,0968344 3,6423600 1,1088027 4,3889612 1,1866521 5,1355625 1,2594295
 5,8821637 1,3271450 6,6287650 1,3898077 7,3753662 1,4474263 8,1219675 1,5000085
 8,8685687 1,5475615 9,6151700 1,590091710,3617712 1,627604811,1083725 1,6601061
11,8549737 1,687599712,6015750 1,710089413,3481762 1,727578314,0947775 1,7400687
14,8413787 1,747562315,5879800 1,750060022,8269800 1,750060043,3578000 1,0331080
43,3578000 1,033108043,3578000 0,0000030
     1     3     5     7     9    10    12    14    16    18    20    22    24    26    28    30
```

```
 SILVER BULLET-WITH SHEATH
35,00       5,0         5,0          5,0          5,0         2500,0      -5,0         5,0
0,50
     3      0
     2
     2     1     1     1     6     6     2    23    25     3     3     1
    31    25    16    25     1    24     3     2     3   300     3     1    50    11
2,54         9,0          89,5         1000,0       0,5          1,8          1,8          0,65
0,8077       0,01219      7,80         0,0
-2,54        0,0          -2,54        1,75         -2,54        9,0
-2,54        9,0          0,0          9,0
0,0          9,0          0,0          1,75         0,0          0,0
     1     2     5
   121    20    21   120     1    17    21     4     2   300    15     2    20    20
46,35        1,65         89,5         1000,0       1,75         1,8          1,0          0,65
1,2967       0,0111       17,04        -0,142
 0,0000000 0,0000000  ,1102360  ,4805076  ,2204720  ,6614160  ,3307080  ,7872425
  ,4409440  ,8818880  ,5511800  ,9546718  ,6614160 1,0103296  ,7716520 1,0515844
 ,8818880 1,0800078  ,9921240 1,0969344 1,1023600 1,1088027 1,8489612 1,1866521
 2,5955625 1,2594295 3,3421637 1,3271450 4,0887650 1,3898077 4,8353662 1,4474263
 5,5819675 1,5000085 6,3285687 1,5479615 7,0751700 1,5900917 7,8217712 1,6276048
 8,5683725 1,6367822
 8,5683725 1,6367822 8,5683725 1,5307012 9,0763725 1,51739A740,3488525  ,6985000
40,3488525  ,698500040,3488525 0,0000000
     1     3     5     7     9    11    13    15    17    19    21    22    23    24    25
    61    20    11    60     1    17     4    12     2   300    11     3    20    20
41,40        1,75         89,5         1000,0       1,75         1,8          1,8          0,65
0,796        0,0192       8,00         -0,142
40,3488525 0,000000040,3488525  ,6985000 9,0763725 1,5173987 9,0763725 1,6585302
 9,0763725 1,6585302 9,5282385 1,6759266 9,9801045 1,691489610,431970S 1,7052198
10,8838365 1,717117911,3357025 1,727184611,7875685 1,735420312,2394345 1,7418254
12,6913005 1,746400213,1431665 1,749145113,5950325 1,750060041,3468525 1,0685780
41,3468525 1,068578041,3468525 0,0000000
     1     2     3     4     6     8    10    12    14    15    16
```

```
 CASE 1
20.0        4,0          4,0          4,0          4,0          600.0        -2.0         0.5
0.50
     2     0
     1
     2
    31    21    16    25     1    20     3     2     4   300     5     5    50    11
0.635        4,0          89,5         1000.0       0,5          1.8          1.8          0,65
0.274        0,0052       2,79         0,0
-0,635       0,0          -0,635       0,390        -0,635       4,0
-0,635       4,0          0,0          4,0
0.0          4,0          0,0          0,4          0,0          0,276        0,0          0,0
     1     2     3     4     5
    61    12    31    80     1    10     4     5     4   300    11     1    25    11
2.159        0,390        89,5         1000,0       0,390        1.8          1,9          0,65
0.8          0,01195      7,8          -0,0371
0.0          0,0          0,0          0,1          0,0          0,2          0,0          0,276
0.0          0,276        0,631        0,390        1,0          0,390        1,5          0,390
2.159        0,390
2.159        0,390        2,159        0,276        2,159        0,150        2,159        0,0
     1     2     3     4     5     6     7     8     9    10    11
```

```
 CASE 2
40.0        5.0         5.0         5.0         5.0         600.0       -3.0        1.0
0.50
     2      0
     1
     2      1     1     1     9     9
    41     21    16    35     1    20     5     2     4   300     7     5    50    11
1.270        2.5          89.5         1000.0       0.4          1.8          1.8          0.65
0.274        0.0052       2.79         0.0
-1.27.       0.0          -1.270       0.127        -1.270       0.254        -1.270       0.3
-1.270       2.5
-1.270       2.5          0.0          2.5
0.0          2.5          0.0          0.3          0.0          0.15         0.0          0.0
     1      2     3     4     5     6     7
   111     11    11   110     1    10    21     3     3   300    15     1    40    11
5.080        0.254        89.5         1000.0       0.254        1.8          1.8          0.65
0.857        0.01541      7.8          -0.0343
     0.00000      0.00000      .01270       .07931       .02540       .11072       .03810       .13380
      .05080       .05240       .06350       .16801       .07620       .18139       .08890       .19302
      .10160       .10320       .11430       .21213       .12700       .21997       .13970       .22683
      .15240       .23279       .16510       .23793       .17780       .24230       .19050       .24593
      .20320       .24887       .21590       .25113       .22860       .25273       .24130       .25368
      .25400       .25400
0.254        0.254        2.5          0.254        5.080        0.254
5.080        0.254        5.080        0.127        5.080        0.0
     1      3     5     7     9    11    13    15    17    19    21    22    23    24    25
```

```
 CASE 3
20.0        2.0         2.0         2.0         2.0         600.0       -3.0        1.0
0.50
     2      0
     1
     2     6     8     1    10     9
    31    31    11    25     1    20     6     2     6   300     9     5    50    11
1.875       8.0         89.5        1000.0      1.0         1.8         1.8         0.65
0.274       0.0052      2.79        0.0
-1.875      0.0         -1.875      0.250       -1.875      0.5         -1.875      0.8
-1.875      1.0         -1.875      8.0
-1.875      8.0         0.0         8.0
0.0         8.0         0.0         1.0         0.0         0.830       0.0         0.530
0.0         0.25        0.0         0.0
     1     2     3     4     5     6     8    11    12
    70    15    20    69     3    13     6     3     6   300    12     1    25    11
3.550       0.30        89.5        1000.0      0.30        1.8         1.8         0.65
0.837       0.01541     7.8         -0.122
3.550       0.68        3.550       0.530       3.0         0.530       2.0         0.530
1.0         0.530       0.0         0.530
0.0         0.530       0.0         0.680       0.0         0.830
0.0         0.830       1.0         0.830       2.0         0.830       3.0         0.830
3.550       0.830       3.550       0.680
     1     2     3     4     5     6     7     8     9    10    11    12
```

```
 CASE 4
40,0        5,0         5,0         5,0         5,0         600,0       =5.0        2,5
0.50
     3     0
     2
     2     1     1     1    10    10     2    27    51     3    21     1
    41    21    16    35     1    20     6     2     4   200     7     1    50    11
2.540       6,0         89,5        1000.0      0,8         1,8         1.8         0,65
0,8077      0,01219     7,8         0,0
-2,540      0,0         -2,540      0,2         -2,540      0,4         =2.540      0,6
-2,540      0,8         -2,540      6.0
-2,540      6,0         0,0         6.0
0.0         6,0         0,0         0,8         0,0         0,6         0.0         0,0
     1     2     3     4     5     8     9
    55    11     4    54     1    10    25     3    25   200    16     6    25    11
20,0        0,667       89,5        1000.0      0,667       1,8         1.8         0,65
2.387       0,00379     14,5        =0,1372
0.5         1,04        3,08        2.5         10,0        10,0        0.0111      0,225
0.056       =0.00126
    0,00000    0,00000     ,07090     .07604     ,14180     ,14367     ,21270     ,20585
     ,28360     ,26299     ,35450     .31546     ,42540     ,36355     ,49630     ,40750
     ,56720     ,44753     ,63810     .48382     ,70900     ,51652     ,77990     ,54576
     ,85080     ,57166     ,92170     .59430     ,99260     ,61378    1.06350     ,63015
    1,13440     ,64347    1,20530     .65379    1,27620     ,66114    1,34710     ,66554
1.418       0,667       5,0         0.667       10,0        0,667       15.0        0,667
20,0        0,667
20,0        0,667       20,0        0.46        20,0        0,263
20,0        0,263       15,0        0.263       10,0        0,263       5.0         0,263
    1,41800     ,26300    1,38045     .26247    1,34290     ,26089    1,30535     ,25824
    1,26780     ,25453    1,23025     .24976    1,19270     ,24391    1,15515     ,23698
    1,11760     ,22895    1,08005     .21983    1,04250     ,20958    1,00495     ,19821
     ,96040     ,18569     ,92985     .17200     ,89230     ,15713     ,85475     ,14105
     ,81220     ,12373     ,77965     .10515     ,74210     ,08527     ,70455     ,06406
     ,66700    0,00000
     1     5     9    13    17    21    23    25    27    29    31    35    39    43    47    51
    51     9    10    50     1     8    21     5     3   200     6     1    20    10
20,0        0,263       89,5        1000.0      0,263       1,8         1.8         0,65
0.274       0,0052      2,79        =0.1372
     ,66700    0,00000     ,70455     .06406     ,74210     ,08527     ,77965     ,10515
     ,81220     ,12373     ,85475     .14105     ,89230     ,15713     ,92985     ,17200
     ,96040     ,18569    1,00495     .19821    1,04250     ,20958    1,08005     ,21983
    1,11760     ,22895    1,15515     .23698    1,19270     ,24391    1,23025     ,24976
    1,26780     ,25453    1,30535     .25824    1,34290     ,26089    1,38045     ,26247
    1,41800     ,26300
1.418       0,263       5,0         0.263       10,0        0,263       15.0        0,263
20,0        0,263
20,0        0,263       20,0        0,13        20,0        0,0
    22    23    24    25    26    27
```

```
CASE 5
20,0        2,0         2,0         2,0         2,0         600,0       -3,0        5,0
0,50
    3     0
    2
    2     1     1     1     8     8     2    21    59     3    36     1
   31    21    16    25     1    20     4     2     4   200     7     1    50    11
0,9525      16,0        89,5        1000,0      2,0         1,8         1,8         0,65
0,0077      0,01219     7,8         0,0
-0,9525     0,0         -0,9525     1,0         -0,9525     2,0         -0,9525     16,0
-0,9525     16,0        0,0         16,0
0,0         16,0        0,0         2,0         0,0         1,6         0,0         0,0
    1     2     3     4     5     6     7
   59    11     8    58     1    10    21     4    37   200    31     2    50    10
23,5        1,633       89,5        1000,0      1,633       1,8         1,8         0,65
1,2967      0,0111      17,04       -0,1524
    0,00000     0,00000     ,08165      ,50990      ,16330      ,71181      ,24495      ,86024
     ,32660      ,97980      ,40825     1,08013      ,48990     1,16620      ,57155     1,24097
     ,65320     1,30640      ,73485     1,36382      ,81650     1,41422      ,89815     1,45832
     ,97980     1,49667     1,06145     1,52971     1,14310     1,55778     1,22475     1,58115
    1,30640     1,60001     1,38805     1,61452     1,46970     1,62481     1,55135     1,63096
    1,63300     1,63300
1,633       1,633       3,0         1,633       4,0         1,633       4,898       1,633
    4,89800     1,63300     4,89800     1,33900     4,92800     1,24900     4,94300     1,23188
    4,95800     1,21900     4,97300     1,20910     4,98800     1,20152     5,00300     1,19591
    5,01800     1,19200     5,03300     1,18975     5,04800     1,18900     6,00000     1,18900
10,0        1,189       13,0        1,189       16,0        1,189       19,0        1,189
   22,23900     1,18900    22,30295     1,18728    22,36690     1,18210    22,43085     1,17342
   22,49480     1,16116    22,55875     1,14520    22,62270     1,12539    22,68665     1,10151
   22,75060     1,07331    22,81455     1,04041    22,87850     1,00238    22,94245      ,95858
   23,00640      ,90820    23,07035      ,85005    23,13430      ,78241    23,19825      ,70254
   23,26220      ,60563    23,32615      ,48148    23,39010      ,29781    23,45405     0,00000
   23,51800     0,00000
     1     3     5     7     9    11    13    15    17    19    21    22    23    24    25    28
    31    34    35    36    37    38    39    40    43    46    49    52    55    58    60
    59    11     8    58     1    10    36     4     3   200     6     3    50    10
24,5        1,633       89,5        1000,0      1,633       1,8         1,8         0,65
0,796       0,0192      8,07        -0,1524
   23,51800     0,00000    23,45405     0,00000    23,39010      ,29781    23,32615      ,48148
   23,26220      ,60563    23,19825      ,70254    23,13430      ,78241    23,07035      ,85005
   23,00640      ,90820    22,94245      ,95858    22,87850     1,00238    22,81455     1,04041
   22,75060     1,07331    22,68665     1,10151    22,62270     1,12539    22,55875     1,14520
   22,49480     1,16116    22,43085     1,17342    22,36690     1,18210    22,30295     1,18728
22,239      1,189       17,0        1,189       13,0        1,189       9,0         1,189
    5,04800     1,18900     5,03300     1,18975     5,01800     1,19203     5,00300     1,19591
    4,98800     1,20152     4,97300     1,20910     4,95800     1,21900     4,94300     1,23188
    4,92800     1,24900     4,91300     1,27362     4,89800     1,33900     4,89800     1,63300
4,898       1,633       10,0        1,633       20,0        1,633       29,398      1,633
29,398      1,633       29,398      0,8         29,398      0,0
   36    37    38    39    40    41
```

4.3 Diagnostics

TOO MANY POINTS ON INTERFACE OF MATERIAL XX WITH MATERIAL XX - In subroutine ADJINT when attempting to replace the interface boundary points of material 2 with those of material 1, the material 2 boundary would exceed it's maximum allowable size. Rerun allowing for more points on material two boundary.

AT POINT (XX,XX) IN FDIFF AT T=XX.XXXXX STAB=XX.XXXXX MAT=XX - Solution may be going unstable at this point. If it does not correct itself try larger artificial viscosity coefficient.

AT POINT (XX,XX) IMAGINARY SOUND SPEED IN FDIFF MAT=XX ESY=XX.XXXXX T=XX.XXXXX - Solution unstable at this point and will be recomputed in ONESTP. If it does not correct itself try larger artificial viscosity coefficient.

AT POINT (XX,XX) IN ONESTP AT T=XX.XXXXX IPOINT=XX STAB=XX.XXXX RHO=XX.XXXX U=XX.XXXX V=XX.XXXX DELA=XX.XXXX DELB=XX.XXXX B SUB R=XX.XXXX MAT=XX - Solution may be going unstable at this point. If it does not correct itself try larger artificial viscosity coefficient.

AT POINT (XX,XX) IMAGINARY SOUND SPEED IN ONESTP RHO=XX.XXXXX U=XX.XXXXX V=XX.XXXXX T=XX.XXXXX MAT=XX - Solution unstable at this point and will be recomputed by interpolation. If it does not correct itself try larger artificial viscosity coefficient.

AT T=XX.XXXXX DENSITY DOES NOT CONVERGE ON MATERIAL X BOUNDARY AT POINT XX - In subroutine DENSB or subroutine INFACE iteration for density to obtain pressure that satisfies proper normal stress boundary condition does not converge. This is usually a sign of an instability in the solution.

MATERIAL X BOUNDARY EXCEEDS DOMAIN - RUN ABORTED (ZMAX,RMAX)/(Z(I),R(I)) - A shift was attempted in subroutine FINISH but there was no room. The boundary coordinates are printed in α-β space. The minimum is zero and the maximum is the printed value. Rerun allowing more points in the proper coordinate direction.

AT X=XX MATERIAL X BOUNDARY CROSSED MORE THAN X TIMES T=XX.XXXXX - The boundary crossed a mesh line more than the maximum number of times allowed in subroutine BPOSN. The boundary points should be examined to see if this indicates an instability or if more crossings should be allowed.

4.4 Sample Output

A sample of the output for the two Silver Bullet runs (6.0) follows. The input data for all materials appears first. Printer plot and printed output at each selected time interval will appear next. The printed output is described in the writeup for subroutine OUTPUT in Section 2. A listing of the complete output for the two problems at time t=0 is given.

MATERIAL 1

MAXIMUM ALPHA MESH= 31 | MAXIMUM BETA MESH= 25 | INITIAL LEFTMOST ALPHA LINE= 16
INITIAL RIGHTMOST ALPHA LINE= 25 | INITIAL TOPMOST BETA LINE= 24 | INITIAL MATERIAL THICKNESS= 2,540
INITIAL MATERIAL HEIGHT= 9,000 | MATERIAL ANGLE= 89,50 | CAP LENGTH=*********
BOUNDARY LAYER THICKNESS= ,500 | ONESTEP VISCOSITY COEFFICIENT=1,8000 | TWOSTEP VISCOSITY COEFFICIENT=1,8000
TIME STEP FACTOR= ,650 | SHEAR MODULUS= ,80770 | YIELD CONDITION= ,01219
INITIAL MATERIAL DENSITY= 7,890 | INITIAL MATERIAL VELOCITY= 0.000000

INITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE

0,00000 0,00000 | 0,00000 1,75000 | 0,00000 9,00000

INITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE

0,00000 9,00000 | 2,54000 9,00000

INITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE

2,54000 9,00000 | 2,54000 1,75000 | 2,54000 0,00000

INITIAL (Z,R) COORDINATES OF TRACER PARTICLES

1) 0,00000 0,00000 | 2) 0,00000 1,75000 | 3) 2,54000 1,75000

MATERIAL 2

MAXIMUM ALPHA MESH= 121 | MAXIMUM BETA MESH= 20 | INITIAL LEFTMOST ALPHA LINE= 21
INITIAL RIGHTMOST ALPHA LINE= 120 | INITIAL TOPMOST BETA LINE= 17 | INITIAL MATERIAL THICKNESS= 40,820
INITIAL MATERIAL HEIGHT= 1,750 | MATERIAL ANGLE= 89,50 | CAP LENGTH=*********
BOUNDARY LAYER THICKNESS= 1,750 | ONESTEP VISCOSITY COEFFICIENT=1,8000 | TWOSTEP VISCOSITY COEFFICIENT=1,8000
TIME STEP FACTOR= ,650 | SHEAR MODULUS= 1,29670 | YIELD CONDITION= ,01110
INITIAL MATERIAL DENSITY= 17,040 | INITIAL MATERIAL VELOCITY= -,142000

INITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE

2,54000 0,00000 | 2,65024 ,48051 | 2,76047 ,66142 | 2,87071 ,76724 | 2,98094 ,88169
3,09118 ,95467 | 3,20142 1,01033 | 3,31165 1,05154 | 3,42189 1,08009 | 3,53212 1,09683

INITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE

3,53212 1,09683 | 3,64236 1,10680 | 4,38896 1,18665 | 5,13554 1,25943 | 5,89216 1,32715
6,62877 1,38981 | 7,37537 1,44743 | 8,12197 1,50001 | 8,86857 1,54756 | 9,61517 1,59009
10,36177 1,62760 | 11,10837 1,66011 | 11,85497 1,68760 | 12,60159 1,71009 | 13,34818 1,72758
14,09476 1,74007 | 14,84138 1,74756 | 15,58798 1,75006 | 22,82698 1,75006 | 43,35780 1,83311

INITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE

43,35780 1,83311 | 43,35780 0,00000

INITIAL (Z,R) COORDINATES OF TRACER PARTICLES

1) 2,54000 0,00000 | 2) 2,76047 ,66142 | 3) 2,98094 ,88169 | 4) 3,20142 1,01033 | 5) 3,42189 1,08009
6) 3,53212 1,09683 | 7) 4,38896 1,18665 | 8) 5,89216 1,32715 | 9) 7,37537 1,44743 | 10) 8,86857 1,54756
11) 10,36177 1,62760 | 12) 11,85497 1,68760 | 13) 13,34818 1,72758 | 14) 14,84138 1,74756 | 15) 22,82698 1,75006
16) 43,35780 0,00000

T= 0.
n CYCLES

T= 0. MICROSECONDS   DT= 0. MICROSECONDS   0 CYCLES   ELAPSED TIME= .957 SECONDS

MATERIAL 1

PT.	Z	R	RHO	U	V	E	SZZ	SZR	SRR	P
	CMS	CMS	GRAMS CM**3	CMS MICROSEC	CMS MICROSEC	10**12 ERGS GRAM	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2
1	.0000	.0001	.78000E+01	0.	0.	0.	0.	0.	0.	0.
2	-.0000	.0401	.78000E+01	0.	0.	0.	0.	0.	0.	0.
3	-.0000	.0837	.78000E+01	0.	0.	0.	0.	0.	0.	0.
4	-.0000	.1296	.78000E+01	0.	0.	0.	0.	0.	0.	0.
5	-.0000	.1779	.78000E+01	0.	0.	0.	0.	0.	0.	0.
6	-.0000	.2322	.78000E+01	0.	0.	0.	0.	0.	0.	0.
7	-.0000	.2891	.78000E+01	0.	0.	0.	0.	0.	0.	0.
8	-.0000	.3502	.78000E+01	0.	0.	0.	0.	0.	0.	0.
9	-.0000	.4155	.78000E+01	0.	0.	0.	0.	0.	0.	0.
10	-.0000	.4855	.78000E+01	0.	0.	0.	0.	0.	0.	0.
11	-.0000	.5601	.78000E+01	0.	0.	0.	0.	0.	0.	0.
12	-.0000	.6404	.78000E+01	0.	0.	0.	0.	0.	0.	0.
13	-.0000	.7259	.78000E+01	0.	0.	0.	0.	0.	0.	0.
14	-.0000	.8172	.78000E+01	0.	0.	0.	0.	0.	0.	0.
15	-.0000	.9145	.78000E+01	0.	0.	0.	0.	0.	0.	0.
16	-.0000	1.0184	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-.0000	1.1291	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-.0000	1.2463	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-.0000	1.3721	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-.0000	1.5051	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-.0000	1.6463	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.0000	1.7963	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.0000	1.9545	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.0000	2.1222	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.0000	2.2993	.78000E+01	0.	0.	0.	0.	0.	0.	0.
26	-.0001	2.4861	.78000E+01	0.	0.	0.	0.	0.	0.	0.
27	-.0001	2.6823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
28	-.0001	2.8897	.78000E+01	0.	0.	0.	0.	0.	0.	0.
29	-.0001	3.1070	.78000E+01	0.	0.	0.	0.	0.	0.	0.
30	-.0001	3.3347	.78000E+01	0.	0.	0.	0.	0.	0.	0.
31	-.0001	3.5731	.78000E+01	0.	0.	0.	0.	0.	0.	0.
32	-.0001	3.8219	.78000E+01	0.	0.	0.	0.	0.	0.	0.
33	-.0001	4.0814	.78000E+01	0.	0.	0.	0.	0.	0.	0.
34	-.0001	4.3513	.78000E+01	0.	0.	0.	0.	0.	0.	0.
35	-.0001	4.6315	.78000E+01	0.	0.	0.	0.	0.	0.	0.
36	-.0001	4.9217	.78000E+01	0.	0.	0.	0.	0.	0.	0.
37	-.0001	5.2218	.78000E+01	0.	0.	0.	0.	0.	0.	0.
38	-.0001	5.5313	.78000E+01	0.	0.	0.	0.	0.	0.	0.
39	-.0001	5.8495	.78000E+01	0.	0.	0.	0.	0.	0.	0.
40	-.0001	6.1762	.78000E+01	0.	0.	0.	0.	0.	0.	0.
41	-.0001	6.5105	.78000E+01	0.	0.	0.	0.	0.	0.	0.
42	-.0001	6.8512	.78000E+01	0.	0.	0.	0.	0.	0.	0.
43	-.0001	7.1975	.78000E+01	0.	0.	0.	0.	0.	0.	0.
44	-.0001	7.5525	.78000E+01	0.	0.	0.	0.	0.	0.	0.
45	-.0001	7.9101	.78000E+01	0.	0.	0.	0.	0.	0.	0.
46	-.0000	8.2711	.78000E+01	0.	0.	0.	0.	0.	0.	0.

109	2.5400	.3410	.780000E+01	0.	0.	0.	0.	0.	0.	0.
110	2.5400	.2818	.780000E+01	0.	0.	0.	0.	0.	0.	0.
111	2.5400	.2264	.780000E+01	0.	0.	0.	0.	0.	0.	0.
112	2.5400	.1747	.780000E+01	0.	0.	0.	0.	0.	0.	0.
113	2.5400	.1264	.780000E+01	0.	0.	0.	0.	0.	0.	0.
114	2.5400	.0813	.780000E+01	0.	0.	0.	0.	0.	0.	0.
115	2.5400	.0393	.780000E+01	0.	0.	0.	0.	0.	0.	0.
116	2.5400	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.

INTERIOR POINTS

2

16	.1270	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
17	.3810	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
18	.6350	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
19	.8890	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
20	1.1430	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
21	1.3970	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
22	1.6510	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
23	1.9050	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
24	2.1590	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.
25	2.4130	.0000	.780000E+01	0.	0.	0.	0.	0.	0.	0.

3

16	.1270	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
17	.3810	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
18	.6350	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
19	.8890	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
20	1.1430	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
21	1.3970	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
22	1.6510	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
23	1.9050	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
24	2.1590	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.
25	2.4130	.0823	.780000E+01	0.	0.	0.	0.	0.	0.	0.

4

16	.1270	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
17	.3810	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
18	.6350	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
19	.8890	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
20	1.1430	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
21	1.3970	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
22	1.6510	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
23	1.9050	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
24	2.1590	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.
25	2.4130	.1770	.780000E+01	0.	0.	0.	0.	0.	0.	0.

5

16	.1270	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
17	.3810	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
18	.6350	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
19	.8890	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
20	1.1430	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
21	1.3970	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
22	1.6510	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
23	1.9050	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
24	2.1590	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.
25	2.4130	.2956	.780000E+01	0.	0.	0.	0.	0.	0.	0.

6

16	.1270	.4139	.780000E+01	0.	0.	0.	0.	0.	0.	0.

TRACER PARTICLES

MATERIAL 2

PT.	Z	R	RHO	U	V	E	SZZ	SZR	SRR	P
	CMS	CMS	GRAMS CM**3	CMS MICROSEC	CMS MICROSEC	10**12 ERGS GRAM	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2
1	2.5400	.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
2	2.5520	.0525	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
3	2.5641	.1050	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
4	2.5761	.1574	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
5	2.5882	.2099	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
6	2.6002	.2624	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
7	2.6123	.3149	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
8	2.6243	.3674	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
9	2.6363	.4199	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
10	2.6484	.4724	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
11	2.6770	.5244	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
12	2.7087	.5764	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
13	2.7403	.6283	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
14	2.7768	.6800	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
15	2.8217	.7313	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
16	2.8667	.7826	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
17	2.9241	.8331	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
18	2.9832	.8834	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
19	3.0573	.9323	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
20	3.1415	.9801	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
21	3.2422	1.0256	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	3.3689	1.0664	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	3.5321	1.0968	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.7206	1.1170	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	3.9098	1.1367	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.0989	1.1564	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	4.2880	1.1761	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	4.4779	1.1953	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	4.6688	1.2139	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	4.8596	1.2325	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	5.0504	1.2511	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	5.2421	1.2691	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.4345	1.2865	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.6269	1.3040	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8193	1.3214	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.0127	1.3381	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.2067	1.3544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	6.4006	1.3707	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	6.5945	1.3869	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	6.7897	1.4027	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
41	6.9850	1.4173	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
42	7.1804	1.4324	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
43	7.3757	1.4475	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
44	7.5724	1.4613	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
45	7.7691	1.4752	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
46	7.9658	1.4890	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
47	8.1628	1.5028	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
48	8.3607	1.5159	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
49	8.5587	1.5279	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
50	8.7566	1.5404	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

233	43.3578	.1035	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
234	43.3578	.1087	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
235	43.3578	.0644	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
240	43.3578	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.

21	2.7441	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.

21	2.7441	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.1066	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.

21	2.7441	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.2126	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.

30	6.4179	.2120	.1704E+02	-.1423E+00	0.						
31	6.8261	.2120	.1734E+02	-.1423E+00	0.						
32	7.2343	.2120	.1764E+02	-.1423E+00	0.						
33	7.6425	.2120	.1794E+02	-.1423E+00	0.						
34	8.0507	.2120	.1824E+02	-.1423E+00	0.						
35	8.4589	.2120	.1854E+02	-.1423E+00	0.						
36	8.8671	.2120	.1884E+02	-.1423E+00	0.						
37	9.2753	.2120	.1914E+02	-.1423E+00	0.						
38	9.6835	.2120	.1944E+02	-.1423E+00	0.						
39	10.0917	.2120	.1974E+02	-.1423E+00	0.						
40	10.4999	.2120	.2004E+02	-.1423E+00	0.						
21	2.7441	.3180	.1704E+02	-.1423E+00	0.						
22	3.1523	.3180	.1734E+02	-.1423E+00	0.						
23	3.5605	.3180	.1764E+02	-.1423E+00	0.						
24	3.9687	.3180	.1794E+02	-.1423E+00	0.						
25	4.3769	.3180	.1824E+02	-.1423E+00	0.						
26	4.7851	.3180	.1854E+02	-.1423E+00	0.						
27	5.1933	.3180	.1884E+02	-.1423E+00	0.						
28	5.6015	.3180	.1914E+02	-.1423E+00	0.						
29	6.0097	.3180	.1944E+02	-.1423E+00	0.						
30	6.4179	.3180	.1974E+02	-.1423E+00	0.						
31	6.8261	.3180	.2004E+02	-.1423E+00	0.						
32	7.2343	.3180	.2034E+02	-.1423E+00	0.						
33	7.6425	.3180	.2064E+02	-.1423E+00	0.						
34	8.0507	.3180	.2094E+02	-.1423E+00	0.						
35	8.4589	.3180	.2124E+02	-.1423E+00	0.						
36	8.8671	.3180	.2154E+02	-.1423E+00	0.						
37	9.2753	.3180	.2184E+02	-.1423E+00	0.						
38	9.6835	.3180	.2214E+02	-.1423E+00	0.						
39	10.0917	.3180	.2244E+02	-.1423E+00	0.						
40	10.4999	.3180	.2274E+02	-.1423E+00	0.						
21	2.7441	.4241	.1734E+02	-.1423E+00	0.						
22	3.1523	.4241	.1764E+02	-.1423E+00	0.						
23	3.5605	.4241	.1794E+02	-.1423E+00	0.						
24	3.9687	.4241	.1824E+02	-.1423E+00	0.						
25	4.3769	.4241	.1854E+02	-.1423E+00	0.						
26	4.7851	.4241	.1884E+02	-.1423E+00	0.						
27	5.1933	.4241	.1914E+02	-.1423E+00	0.						
28	5.6015	.4241	.1944E+02	-.1423E+00	0.						
29	6.0097	.4241	.1974E+02	-.1423E+00	0.						
30	6.4179	.4241	.2004E+02	-.1423E+00	0.						
31	6.8261	.4241	.2034E+02	-.1423E+00	0.						
32	7.2343	.4241	.2064E+02	-.1423E+00	0.						
33	7.6425	.4241	.2094E+02	-.1423E+00	0.						
34	8.0507	.4241	.2124E+02	-.1423E+00	0.						
35	8.4589	.4241	.2154E+02	-.1423E+00	0.						
36	8.8671	.4241	.2184E+02	-.1423E+00	0.						
37	9.2753	.4241	.2214E+02	-.1423E+00	0.						
38	9.6835	.4241	.2244E+02	-.1423E+00	0.						
39	10.0917	.4241	.2274E+02	-.1423E+00	0.						
40	10.4999	.4241	.2304E+02	-.1423E+00	0.						
21	2.7441	.5301	.1764E+02	-.1423E+00	0.						
22	3.1523	.5301	.1794E+02	-.1423E+00	0.						
23	3.5605	.5301	.1824E+02	-.1423E+00	0.						
24	3.9687	.5301	.1854E+02	-.1423E+00	0.						
25	4.3769	.5301	.1884E+02	-.1423E+00	0.						

26	4.7851	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.5301	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.6362	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.7422	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	3.1523	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

25	4.3769	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.8483	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
					11					
22	3.1523	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	3.5605	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.9687	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	4.3769	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	.9544	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
					12					
23	3.5605	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	3.9687	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	4.3769	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	5.6015	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.0604	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
					13					
25	4.3769	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	4.7851	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	5.1933	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

28	5.6015	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.1665	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

14

28	5.6015	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	6.0097	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	6.4179	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	6.8261	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.2726	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

15

31	6.8261	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	7.2343	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	7.6425	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	8.0507	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.3787	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

16

34	8.0507	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	8.4589	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	8.8671	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	9.2753	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	9.6835	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.4848	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

17

38	9.6835	1.5908	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	10.0917	1.5908	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	10.4999	1.5908	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

18

TRACER PARTICLES

1	2.5400	.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
2	2.7635	.6613	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
3	2.9814	.8818	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

4	3.2066	1.0095	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
5	3.4292	1.0776	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
6	3.5321	1.0968	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
7	4.3894	1.1864	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
8	5.8825	1.3269	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
9	7.3754	1.4474	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
10	8.8688	1.5473	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
11	10.3618	1.6275	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
12	11.8551	1.6873	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
13	13.3482	1.7274	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
14	14.8414	1.7474	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
15	22.8266	1.7485	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
16	43.3578	.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

MATERIAL 2 FROM POINT 1 TO POINT 1 HAS AN INTERFACE WITH MATERIAL 1 FROM POINT 115 TO POINT 116

SILVER BULLET-WITH SHEATH

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                                              MATERIAL 1
MAXIMUM ALPHA MESH=  31                  MAXIMUM BETA MESH=  25                   INITIAL LEFTMOST ALPHA LINE=  16
INITIAL RIGHTMOST ALPHA LINE=  [illegible] INITIAL TOPMOST BETA LINE=  24          INITIAL MATERIAL THICKNESS=  2,540
INITIAL MATERIAL HEIGHT=   [illegible]   MATERIAL ANGLE=  89,50                    CAP LENGTH=**********
BOUNDARY LAYER THICKNESS=  [illegible]   ONESTEP VISCOSITY COEFFICIENT=1,8000      TWOSTEP VISCOSITY COEFFICIENT=1,6900
TIME STEP FACTOR= ,650                   SHEAR MODULUS=  ,80770                    YIELD CONDITION=   ,01219
INITIAL MATERIAL DENSITY=  7,8[illegible] INITIAL MATERIAL VELOCITY= 0,000000

                                   INITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE
   -2,54000  0,00000          -2,54000  1,75000          -2,54000  9,00000

                                   INITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE
   -2,54000  9,00000           0,00000  9,00000

                                   INITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE
    0,00000  9,00000           0,00000  1,75000           0,00000  0,00000

                                   INITIAL (Z,R) COORDINATES OF TRACER PARTICLES
 1) -2,54000  0,00000      2) -2,54000  1,75000      3)  0,00000  1,75000


                                              MATERIAL 2
MAXIMUM ALPHA MESH= 121                  MAXIMUM BETA MESH=  21                   INITIAL LEFTMOST ALPHA LINE=  21
INITIAL RIGHTMOST ALPHA LINE= 1[illegible] INITIAL TOPMOST BETA LINE=  17          INITIAL MATERIAL THICKNESS= 40,350
INITIAL MATERIAL HEIGHT=   1,651         MATERIAL ANGLE=  89,50                    CAP LENGTH=**********
BOUNDARY LAYER THICKNESS=   1,750        ONESTEP VISCOSITY COEFFICIENT=1,8000      TWOSTEP VISCOSITY COEFFICIENT=1,8000
TIME STEP FACTOR= ,650                   SHEAR MODULUS=  1,27670                   YIELD CONDITION=   ,01110
INITIAL MATERIAL DENSITY= 17,040         INITIAL MATERIAL VELOCITY= -,142000

                                   INITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE
   0,00000  0,00000       ,11024   ,49051        ,22047   ,66142        ,33071   ,78724        ,44094   ,88189
    ,55118   ,95467       ,66142  1,01033        ,77165  1,05159        ,88189  1,08009       ,99212  1,09603
   1,10236  1,10000      1,64096  1,13665       2,39556  1,25943       3,34216  1,32715      4,03877  1,38781
   4,83537  1,44743      5,63197  1,50031       6,32857  1,54756       7,37517  1,59009      7,62177  1,62760
   8,56837  1,63674

                                   INITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE
   8,56837  1,63674      8,56837  1,53073       9,07637  1,51740      40,34885   ,69250

                                   INITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE
  40,34885   ,69250      40,34885  0,00000

                                   INITIAL (Z,R) COORDINATES OF TRACER PARTICLES
 1)  0,00000  0,00000   2)   ,22047   ,66142    3)   ,44094   ,88189    4)   ,50147  1,01033    5)   ,88189  1,08009
 6)  1,10236  1,10000   7)  2,39556  1,25913    8)  4,03877  1,38931    9)  5,50197  1,50031   10)  7,37517  1,59009
11)  8,56837  1,63674  12)  8,56837  1,53070   13)  9,07637  1,51740   14) 40,34885   ,69250   15) 40,34885  0,00000


                                              MATERIAL 3
MAXIMUM ALPHA MESH=  [illegible]         MAXIMUM BETA MESH=  2[illegible]          INITIAL LEFTMOST ALPHA LINE=  11
INITIAL RIGHTMOST ALPHA LINE=  [illegible] INITIAL TOPMOST BETA LINE=  17          INITIAL MATERIAL THICKNESS= 4[illegible],40[illegible]
INITIAL MATERIAL HEIGHT=   [illegible]   MATERIAL ANGLE=  89,50                    CAP LENGTH=**********
BOUNDARY LAYER THICKNESS=   1,7[illegible] ONESTEP VISCOSITY COEFFICIENT=1,8000    TWOSTEP VISCOSITY COEFFICIENT=1,[illegible]
TIME STEP FACTOR= ,65                    SHEAR MODULUS=   ,7[illegible]            YIELD CONDITION=   ,[illegible]
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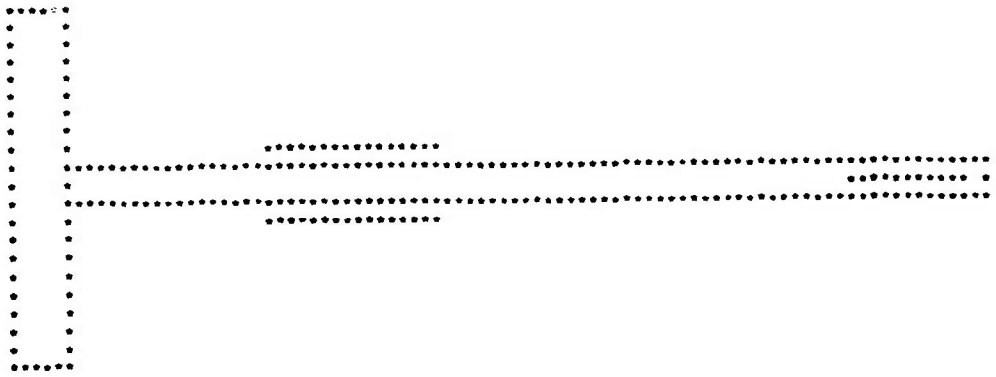
INITIAL MATERIAL DENSITY = [illegible]          INITIAL MATERIAL VELOCITY= -.[illegible]

                              INITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE
    40.34085  [illegible]        41.34685  .69853          9.37637  1.51174        9.17637  1.65653

                              INITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE
     9.07637  1.65653          9.52424  1.67593          9.74918  1.69149         11.43197  1.70522         10.69384  1.71712
    11.33570  1.72724         11.73757  1.73542         12.23913  1.74185         12.69130  1.74640         13.14317  1.74915
    13.59503  1.75006         41.36485  1.06858

                              INITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE
    41.36485  1.06858         41.36485  0.00000

                              INITIAL (Z,R) COORDINATES OF TRACER PARTICLES
 1) 40.34085  0.00000     2) 41.34685  .69853     3)  9.37637  1.51743     4)  9.07637  1.65653     5)  9.93039  1.69149
 6) 10.69384  1.71712     7) 11.70757  1.73512    8) 12.69130  1.74540     9) 13.59503  1.75015    10) 41.36485  1.06858
11) 41.36485  0.00000
```



Ta [illegible] CYCLES

T= 0.
MICROSECONDS

5 CYCLES

ELAPSED TIME= 1.31
SECONDS

MATERIAL 1

PT.	Z	R	RHO	U	V	E	SZZ	SZR	SRR	P
	CMS	CMS	GRAMS CM**3	CMS MICROSEC	CMS MICROSEC	10**12 ERGS GRAM	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2	10**12 DYNES CM**2
1	-2.5400	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
2	-2.5400	.0431	.78000E+01	0.	0.	0.	0.	0.	0.	0.
3	-2.5400	.0832	.78000E+01	0.	0.	0.	0.	0.	0.	0.
4	-2.5400	.1294	.78000E+01	0.	0.	0.	0.	0.	0.	0.
5	-2.5400	.1790	.78000E+01	0.	0.	0.	0.	0.	0.	0.
6	-2.5400	.2322	.78000E+01	0.	0.	0.	0.	0.	0.	0.
7	-2.5400	.2891	.78000E+01	0.	0.	0.	0.	0.	0.	0.
8	-2.5400	.3502	.78000E+01	0.	0.	0.	0.	0.	0.	0.
9	-2.5400	.4156	.78000E+01	0.	0.	0.	0.	0.	0.	0.
10	-2.5400	.4855	.78000E+01	0.	0.	0.	0.	0.	0.	0.
11	-2.5400	.5604	.78000E+01	0.	0.	0.	0.	0.	0.	0.
12	-2.5400	.6409	.78000E+01	0.	0.	0.	0.	0.	0.	0.
13	-2.5400	.7259	.78000E+01	0.	0.	0.	0.	0.	0.	0.
14	-2.5400	.8172	.78000E+01	0.	0.	0.	0.	0.	0.	0.
15	-2.5400	.9146	.78000E+01	0.	0.	0.	0.	0.	0.	0.
16	-2.5400	1.0184	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.5400	1.1291	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-2.5400	1.2468	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-2.5400	1.3721	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-2.5400	1.5051	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-2.5400	1.6463	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-2.5400	1.7960	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-2.5400	1.9545	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-2.5400	2.1222	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-2.5400	2.2993	.78000E+01	0.	0.	0.	0.	0.	0.	0.
26	-2.5400	2.4861	.78000E+01	0.	0.	0.	0.	0.	0.	0.
27	-2.5400	2.6829	.78000E+01	0.	0.	0.	0.	0.	0.	0.
28	-2.5401	2.8897	.78000E+01	0.	0.	0.	0.	0.	0.	0.
29	-2.5401	3.1070	.78000E+01	0.	0.	0.	0.	0.	0.	0.
30	-2.5401	3.3347	.78000E+01	0.	0.	0.	0.	0.	0.	0.
31	-2.5401	3.5730	.78000E+01	0.	0.	0.	0.	0.	0.	0.
32	-2.5401	3.8219	.78000E+01	0.	0.	0.	0.	0.	0.	0.
33	-2.5401	4.0813	.78000E+01	0.	0.	0.	0.	0.	0.	0.
34	-2.5401	4.3513	.78000E+01	0.	0.	0.	0.	0.	0.	0.
35	-2.5401	4.6315	.78000E+01	0.	0.	0.	0.	0.	0.	0.
36	-2.5401	4.9219	.78000E+01	0.	0.	0.	0.	0.	0.	0.
37	-2.5401	5.2220	.78000E+01	0.	0.	0.	0.	0.	0.	0.
38	-2.5401	5.5313	.78000E+01	0.	0.	0.	0.	0.	0.	0.
39	-2.5401	5.8496	.78000E+01	0.	0.	0.	0.	0.	0.	0.
40	-2.5401	6.1762	.78000E+01	0.	0.	0.	0.	0.	0.	0.
41	-2.5401	6.5115	.78000E+01	0.	0.	0.	0.	0.	0.	0.
42	-2.5401	[illegible]	.78000E+01	0.	0.	0.	0.	0.	0.	0.
43	-2.5401	7.1997	.78000E+01	0.	0.	0.	0.	0.	0.	0.
44	-2.5401	7.5562	.78000E+01	0.	0.	0.	0.	0.	0.	0.
45	-2.5401	7.9100	.78000E+01	0.	0.	0.	0.	0.	0.	0.
46	-2.5401	8.2713	.78000E+01	0.	0.	0.	0.	0.	0.	0.

109	-.0000	.3410	.78000E+01	0.	0.	0.	0.	0.	0.	0.
110	-.0000	.2814	.78000E+01	0.	0.	0.	0.	0.	0.	0.
111	-.0000	.2264	.78000E+01	0.	0.	0.	0.	0.	0.	0.
112	-.0000	.1747	.78000E+01	0.	0.	0.	0.	0.	0.	0.
113	-.0000	.1264	.78000E+01	0.	0.	0.	0.	0.	0.	0.
114	-.0000	.0813	.78000E+01	0.	0.	0.	0.	0.	0.	0.
115	-.0000	.0394	.78000E+01	0.	0.	0.	0.	0.	0.	0.
116	.0000	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.

INTERIOR POINTS

2

16	-2.4130	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.1590	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-1.9050	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-1.6510	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.

3

16	-2.4130	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.1590	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-1.9050	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-1.6510	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	.0823	.78000E+01	0.	0.	0.	0.	0.	0.	0.

4

16	-2.4130	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.1590	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-1.9050	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-1.6510	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	.1770	.78000E+01	0.	0.	0.	0.	0.	0.	0.

5

16	-2.4130	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.1590	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-1.9050	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-1.6510	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	.2856	.78000E+01	0.	0.	0.	0.	0.	0.	0.

6

16	-2.4130	.410[illegible]	.78000E+01	0.	0.	0.	0.	0.	0.	0.

7

8

9

10

11

19	-1.6510	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	1.3491	.78000E+01	0.	0.	0.	0.	0.	0.	0.

12

16	-2.4130	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
17	-2.1590	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
18	-1.9050	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
19	-1.6510	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
20	-1.3970	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
21	-1.1430	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
22	-.8890	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
23	-.6350	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
24	-.3810	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.
25	-.1270	1.6176	.78000E+01	0.	0.	0.	0.	0.	0.	0.

TRACER PARTICLES

1	-2.5400	.0000	.78000E+01	0.	0.	0.	0.	0.	0.	0.
2	-2.5400	1.7500	.78000E+01	0.	0.	0.	0.	0.	0.	0.
3	-.0000	1.7500	.78000E+01	0.	0.	0.	0.	0.	0.	0.

MATERIAL 2

PT.	Z CMS	R CMS	RHO GRAMS/CM**3	C CMS/MICROSEC	V CMS/MICROSEC	E 10**12 DYNES/CM**2	SZZ 10**12 DYNES/CM**2	SZR 10**12 DYNES/CM**2	SRR 10**12 DYNES/CM**2	P 10**12 DYNES/CM**2
1	.0000	-.0000	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
2	.0115	.0501	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
3	.0230	.1003	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
4	.0345	.1504	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
5	.0460	.2006	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
6	.0575	.2507	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
7	.0690	.3009	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
8	.0805	.3510	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
9	.0920	.4012	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
10	.1035	.4513	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
11	.1229	.5013	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
12	.1532	.5513	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
13	.1834	.6004	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
14	.2137	.6503	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
15	.2539	.6995	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
16	.2969	.7486	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
17	.3427	.7976	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
18	.3990	.8459	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
19	.4590	.8938	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
20	.5303	.9409	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
21	.6143	.9865	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
22	.7143	1.0301	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
23	.8401	1.0693	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
24	1.0041	1.0981	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
25	1.1904	1.1180	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
26	1.3773	1.1375	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
27	1.5641	1.1570	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
28	1.7510	1.1764	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
29	1.9378	1.1954	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
30	2.1274	1.2139	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
31	2.3161	1.2322	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
32	2.5048	1.2504	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
33	2.6944	1.2684	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
34	2.8849	1.2857	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
35	3.0752	1.3029	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
36	3.2656	1.3202	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
37	3.4570	1.3368	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
38	3.6490	1.3529	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
39	3.8419	1.3687	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
40	4.0331	1.3851	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
41	4.2262	1.4004	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
42	4.4198	1.4154	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
43	4.6134	1.4303	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
44	4.8069	1.4452	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
45	5.0013	1.4591	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
46	5.1963	1.4729	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
47	5.3914	1.4866	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
48	5.5869	1.5003	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
49	5.7832	1.5123	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.
50	5.9794	1.5253	.1704E+02	-.1420E+00	0.	0.	0.	0.	0.	0.

175	30.5476	.9491	.1754E+02	-.1420E+00	0.	0.	0.
176	30.7471	.9496	.1764E+02	-.1420E+00	0.	0.	0.
177	30.9467	.9447	.1754E+02	-.1420E+00	0.	0.	0.
178	31.1471	.9494	.1704E+02	-.1420E+00	0.	0.	0.
179	31.3472	.9542	.1704E+02	-.1420E+00	0.	0.	0.
180	31.5472	.9596	.1704E+02	-.1420E+00	0.	0.	0.
181	31.7472	.9537	.1704E+02	-.1420E+00	0.	0.	0.
182	31.9473	.9105	.1704E+02	-.1420E+00	0.	0.	0.
183	32.1473	.9139	.1704E+02	-.1420E+00	0.	0.	0.
184	32.3474	.9088	.1704E+02	-.1420E+00	0.	0.	0.
185	32.5474	.9028	.1704E+02	-.1420E+00	0.	0.	0.
186	32.7474	.8975	.1704E+02	-.1420E+00	0.	0.	0.
187	32.9475	.8923	.1704E+02	-.1420E+00	0.	0.	0.
188	33.1475	.8871	.1704E+02	-.1420E+00	0.	0.	0.
189	33.3475	.8818	.1704E+02	-.1420E+00	0.	0.	0.
190	33.5476	.8764	.1704E+02	-.1420E+00	0.	0.	0.
191	33.7476	.8713	.1704E+02	-.1420E+00	0.	0.	0.
192	33.9477	.8661	.1704E+02	-.1420E+00	0.	0.	0.
193	34.1477	.8609	.1704E+02	-.1420E+00	0.	0.	0.
194	34.3477	.8556	.1704E+02	-.1420E+00	0.	0.	0.
195	34.5479	.8504	.1704E+02	-.1420E+00	0.	0.	0.
196	34.7478	.8451	.1704E+02	-.1420E+00	0.	0.	0.
197	34.9473	.8399	.1704E+02	-.1420E+00	0.	0.	0.
198	35.1479	.8347	.1704E+02	-.1420E+00	0.	0.	0.
199	35.3479	.8294	.1704E+02	-.1420E+00	0.	0.	0.
200	35.5480	.8242	.1704E+02	-.1420E+00	0.	0.	0.
201	35.7480	.8190	.1704E+02	-.1420E+00	0.	0.	0.
202	35.9480	.8137	.1704E+02	-.1420E+00	0.	0.	0.
203	36.1481	.8085	.1704E+02	-.1420E+00	0.	0.	0.
204	36.3481	.8032	.1704E+02	-.1420E+00	0.	0.	0.
205	36.5481	.7980	.1704E+02	-.1420E+00	0.	0.	0.
206	36.7482	.7928	.1704E+02	-.1420E+00	0.	0.	0.
207	36.9482	.7875	.1704E+02	-.1420E+00	0.	0.	0.
208	37.1483	.7823	.1704E+02	-.1420E+00	0.	0.	0.
209	37.3483	.7771	.1704E+02	-.1420E+00	0.	0.	0.
210	37.5483	.7718	.1704E+02	-.1420E+00	0.	0.	0.
211	37.7484	.7666	.1704E+02	-.1420E+00	0.	0.	0.
212	37.9484	.7613	.1704E+02	-.1420E+00	0.	0.	0.
213	38.1484	.7561	.1704E+02	-.1420E+00	0.	0.	0.
214	38.3485	.7509	.1704E+02	-.1420E+00	0.	0.	0.
215	38.5485	.7456	.1704E+02	-.1420E+00	0.	0.	0.
216	38.7486	.7404	.1704E+02	-.1420E+00	0.	0.	0.
217	38.9486	.7352	.1704E+02	-.1420E+00	0.	0.	0.
218	39.1486	.7299	.1704E+02	-.1420E+00	0.	0.	0.
219	39.3487	.7247	.1704E+02	-.1420E+00	0.	0.	0.
220	39.5487	.7194	.1704E+02	-.1420E+00	0.	0.	0.
221	39.7487	.7142	.1704E+02	-.1420E+00	0.	0.	0.
222	39.9488	.7091	.1704E+02	-.1420E+00	0.	0.	0.
223	40.1488	.7037	.1704E+02	-.1420E+00	0.	0.	0.
224	40.3489	.6985	.1704E+02	-.1420E+00	0.	0.	0.
225	40.3489	.6934	.1704E+02	-.1420E+00	0.	0.	0.
226	40.3489	.6882	.1704E+02	-.1420E+00	0.	0.	0.
227	40.3489	.6830	.1704E+02	-.1420E+00	0.	0.	0.
228	40.3489	.6778	.1704E+02	-.1420E+00	0.	0.	0.
229	40.3489	.6725	.1704E+02	-.1420E+00	0.	0.	0.
230	40.3489	.6673	.1704E+02	-.1420E+00	0.	0.	0.
231	40.3489	.6621	.1704E+02	-.1420E+00	0.	0.	0.
232	40.3489	.6569	.1704E+02	-.1420E+00	0.	0.	0.
233	40.3489	.6517	.1704E+02	-.1420E+00	0.	0.	0.
234	40.3489	.6465	.1704E+02	-.1420E+00	0.	0.	0.
235	40.3489	.6414	.1704E+02	-.1420E+00	0.	0.	0.
236	40.3489	.6362	.1704E+02	-.1420E+00	0.	0.	0.

237	40.3489	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
238	40.3489	-.0099	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

INTERIOR POINTS

2

21	.2018	-.0101	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	-.0100	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	-.0001	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

3

21	.2018	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.0999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

4

21	.2018	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

32	4.6403	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.1999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

5

21	.2018	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.2999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

6

21	.2018	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	[illegible]	.3998	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	1.4123	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.3998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

7

21	.2018	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.4998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

28	3.0263	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.499A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.

8

21	.2018	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
22	.6053	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.599A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.

18

9

22	.6053	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.699A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.

10

22	.6053	.799A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.799A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.799A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.799A	.1704[illegible]+02	-.14200E+00	0.	0.	0.	0.	0.	0.

26	2.2193	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.7998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

11

22	.6053	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
23	1.0088	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.8998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

12

23	1.0088	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
24	1.4123	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
28	3.0263	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
29	3.4298	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
30	3.8333	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
31	4.2368	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
32	4.6403	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
33	5.0438	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
34	5.4473	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
35	5.8508	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
36	6.2543	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
37	6.6578	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
38	7.0613	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
39	7.4648	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	.9998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

13

24	1.4123	1.0998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
25	1.8158	1.0998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
26	2.2193	1.0998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
27	2.6228	1.0998	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

14

15

16

17

39	7.4646	1.4999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	1.4999	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

18

39	7.4646	1.6000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
40	7.8683	1.6000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

TRACER PARTICLES

1	.0000	-.0000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
2	.2227	.6613	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
3	.4436	.8617	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
4	.6571	1.0095	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
5	.8869	1.0779	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
6	1.1027	1.1068	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
7	2.5960	1.2591	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
8	4.0097	1.3896	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
9	5.5820	1.5000	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
10	7.0754	1.5893	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
11	8.5064	1.6368	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
12	8.5996	1.5357	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
13	9.0764	1.5174	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
14	40.3469	.6985	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.
15	40.3469	-.0305	.17040E+02	-.14200E+00	0.	0.	0.	0.	0.	0.

MATERIAL 3

PT.	R CMS	T MS	RHO GM/CC	U CMS/MICROSEC	V CMS/MICROSEC	E 10**12 ERGS/GRAM	SZZ 10**12 DYNES/CM**2	Z? 10**12 DYNES/CM**2	S?? 10**12 DYNES/CM**2	P 10**12 DYNES/CM**2
1	40.3489	.0000	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
2	40.3489	.0533	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
3	40.3489	.1059	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
4	40.3489	.1589	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
5	40.3489	.2119	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
6	40.3489	.2648	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
7	40.3489	.3178	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
8	40.3489	.3708	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
9	40.3489	.4238	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
10	40.3489	.4768	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
11	40.3489	.5297	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
12	40.3489	.5827	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
13	40.3489	.6357	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
14	40.3489	.6887	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
15	40.0184	.7072	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
16	39.6130	.7174	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
17	39.2077	.7284	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
18	38.8124	.7391	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
19	38.3970	.7496	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
20	37.9927	.7602	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
21	37.5964	.7708	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
22	37.1919	.7814	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
23	36.7757	.7921	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
24	36.3704	.8027	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
25	35.9550	.8133	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
26	35.5597	.8239	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
27	35.1544	.8345	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
28	34.7491	.8451	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
29	34.3437	.8557	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
30	33.9384	.8663	.8000E+01	-.14200E+00	-0.	0.	0.	0.	0.	0.
31	33.5331	.8770	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
32	33.1277	.8876	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
33	32.7224	.8982	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
34	32.3171	.9088	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
35	31.9117	.9194	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
36	31.5064	.9300	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
37	31.1011	.9406	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
38	30.6957	.9512	.8000E+01	-.14200E+00	0.	0.	0.	0.	0.	0.
39	30.2904	.9619	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
40	29.8851	.9725	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
41	29.4797	.9831	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
42	29.0744	.9937	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
43	28.6691	1.0043	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
44	28.2637	1.0149	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
45	27.8584	1.0255	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
46	27.453[illegible]	1.0362	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
47	27.[illegible]	1.0468	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
48	26.6424	1.0574	[illegible]	-.14200E+00	0.	0.	0.	0.	0.	0.
49	26.237[illegible]	1.0680	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.
50	25.8[illegible]	1.0786	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.

175	41.3649	.9627	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
176	41.3649	.9093	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
177	41.3649	.8559	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
178	41.3649	.8014	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
179	41.3649	.7479	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
180	41.3649	.6945	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
181	41.3649	.6411	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
182	41.3649	.5876	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
183	41.3649	.5342	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
184	41.3649	.4808	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
185	41.3649	.4273	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
186	41.3649	.3739	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
187	41.3649	.3205	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
188	41.3649	.2671	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
189	41.3649	.2136	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
190	41.3649	.1602	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
191	41.3649	.1068	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
192	41.3649	.0534	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
193	41.3649	.0000	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.

INTERIOR POINTS

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27	22.7384	1.1605	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
28	23.5664	1.1605	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
29	24.3944	1.1605	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
30	25.2224	1.1605	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.

14

22	18.5964	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
23	19.4284	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
24	20.2544	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
25	21.0824	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
26	21.9104	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
27	22.7384	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
28	23.5664	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
29	24.3944	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.
30	25.2224	1.2726	.8000E+01	-.1420E+00	0.	0.	0.	0.	0.	0.

2	40.2874	.5921	[illegible]	[illegible]	0.	0.	.	.	0.	0.
3	9.1679	1.5209	[illegible]	-.1420[illegible]	0.	.	.	.	0.	.
4	9.3764	1.6[illegible]	[illegible]	-.1420[illegible]	0.	.	.	.	.	.
5	9.9807	1.6712	[illegible]	[illegible]	0.	0.	.	.	.	0.
6	10.9344	1.7107	[illegible]	[illegible]	0.	.	0.	.	.	.
7	11.7679	1.7351	[illegible]	-.1420[illegible]	0.	0.	.	.	0.	.
8	12.6724	1.7462	[illegible]	-.1420[illegible]	0.	0.	.	.	0.	0.
9	13.5943	1.7497	[illegible]	-.1420[illegible]E+00	0.	.	.	.	0.	.
10	41.3642	1.[illegible]664	[illegible]	-.1420[illegible]E+00	0.	.	0.	.	0.	0.
11	41.3642	-.0009	[illegible]	-.1420[illegible]	0.	.	.	.	0.	0.

MATERIAL 2 FROM POINT 1 TO POINT 1 HAS AN INTERFACE WITH MATERIAL 1 FROM POINT 115 TO POINT 110

MATERIAL 2 FROM POINT 46 TO POINT 234 HAS AN INTERFACE WITH MATERIAL 3 FROM POINT 91 TO POINT 1
REZONING MATERIAL 3 SURFACE 1 DELS= .7682725 DISMIN= .3566462 DISMAX= .3976521 T= .12311

V. PROGRAM LISTING

```
      PROGRAM SMITE(INPUT,OUTPUT,TAPE1,TAPE2,TAPE5 = INPUT,TAPE6 = OUTPUSMITE  2
     1T)                                                                SMITE  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,DAL,KMAX,PURG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /TVALS/ ISTART,TMAX,TPRIN,TFRPL,TPLOT,TSAVE,TCOMP,TZ       TVALS  2
      LOGICAL ERR                                                       SMITE  7
      CALL INITAL                                                       SMITE  8
      TPRN = AKT+TPRIN                                                  SMITE  9
      TPRT = AKT+TPRPL                                                  SMITE 10
      TPLT = AKT+TPLOT                                                  SMITE 11
      TSVE = AKT+TSAVE                                                  SMITE 12
   10 KT = KT+1                                                         SMITE 13
      DT = 1.0E6                                                        SMITE 14
      DO 20 MAT = 1,NMAT                                                SMITE 15
      IF (FMAT(22,MAT),GE,DT) GO TO 20                                  SMITE 16
      DT = FMAT(22,MAT)                                                 SMITE 17
      MT = MAT                                                          SMITE 18
   20 CONTINUE                                                          SMITE 19
      IF (DT,GT,DTMIN) GO TO 30                                         SMITE 20
      ZZ = FLOAT(IMAT(8,MT)-1)*FMAT(1,MT)                               SMITE 21
      RR = FLOAT(IMAT(9,MT)-2)*FMAT(2,MT)                               SMITE 22
      WRITE (6,120) AKT,MT,ZZ,RR,DT                                     SMITE 23
      GO TO 100                                                         SMITE 24
   30 AKT = AKT+DT                                                      SMITE 25
      CALL MVBND                                                        SMITE 26
      CALL ADJINT                                                       SMITE 27
      CALL BONDRY                                                       SMITE 28
      CALL DENSB                                                        SMITE 29
      DO 40 MAT = 1,NMAT                                                SMITE 30
      CALL GENVAL                                                       SMITE 31
      CALL FDIFF                                                        SMITE 32
      CALL FINISH                                                       SMITE 33
      CALL BPOSN                                                        SMITE 34
      CALL BVALU                                                        SMITE 35
      CALL INTRPL                                                       SMITE 36
   40 CONTINUE                                                          SMITE 37
      IF (ERR) GO TO 100                                                SMITE 38
      CALL SECOND (T)                                                   SMITE 39
      IF (T,GE,TCOMP,OR,AKT,GE,TMAX) GO TO 90                           SMITE 40
      IF (AKT,LT,TPRT) GO TO 50                                         SMITE 41
      CALL PRNPLT                                                       SMITE 42
      TPRT = TPRT+TPRPL                                                 SMITE 43
   50 IF (AKT,LT,TPLT) GO TO 60                                         SMITE 44
      CALL PLTOUT                                                       SMITE 45
      TPLT = TPLT+TPLOT                                                 SMITE 46
   60 IF (AKT,LT,TPRN) GO TO 70                                         SMITE 47
      CALL OUTPUT                                                       SMITE 48
      TPRN = TPRN+TPRIN                                                 SMITE 49
   70 IF (AKT,LT,TSVE) GO TO 80                                         SMITE 50
      CALL SAVE                                                         SMITE 51
      TSVE = TSVE+TSAVE                                                 SMITE 52
   80 GO TO 10                                                          SMITE 53
   90 IF (TSVE,LT,1.0E8) CALL SAVE                                      SMITE 54
  100 IF (TPLT,GE,1.0E8) GO TO 110                                      SMITE 55
      CALL PLTOUT                                                       SMITE 56
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      END FILE 2                                                                SMITE 57
  110 IF (TPRT.LT.1.0E8) CALL PRNPLT                                            SMITE 58
      IF (TPRN.LT.1.0E8) CALL OUTPUT                                            SMITE 59
      STOP                                                                      SMITE 60
C                                                                               SMITE 61
  120 FORMAT (6H0AT T=F8.3,27H STEP TOO SMALL IN MATERIALI2,16H AT POINTSMITE 62
     1 (Z,R)=2E11.4,5X3HDT=E11.4)                                               SMITE 63
      END                                                                       SMITE 64
```

```
      SUBROUTINE INITAL                                                 INITAL 2
      COMMON// W(2200,7),L(2200)                                        INITAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(600,7),FBX(600),FBY(600),FBS(600)              BNDVAL 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),AREAIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON/MSHFCN/ Y(78),DY(78),DYA(78),FSY(78),YSE(78),ESYA(78),     MSHFCN 2
     1YSEA(78),ESYE(78),EIGF(78),ASY(78),AYY(78),ASYA(78)               MSHFCN 3
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON/SCRTCH/ TWB(300,7),TFBX(300),TFBY(300)                     SCRTCH 2
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,ML,YC,RHO,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1APL,CHAN,HMAX,FACT,ANG,AF,SRT,AL,AS,AK,HAL,HAS,HAK,CAL,CAS,CAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWOML,ERTOMU,OOVMMATVAL 4
     3U,IPEQTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NF,NF1MATVAL 5
     4,NP,NIP2,NTR                                                      MATVAL 6
      COMMON /PRESS/ PDER,PH,PE,MATNO                                   PRESS  2
      COMMON /EQSTP/ APL(10),BPL(10),APB(10),BPB(10),ALPH(10),BETA(10),EQSTP  2
     1S(10),EZERO(10),ESPHM(10),PHOZRO(10),PMIN(10)                     EQSTP  3
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIER,IFOINT,ERR,EPS,EPS1,RDICOMVAL
     1S,IOP,DAL,KMAX,PORG,PSCL,LF,LP                                    COMVAL
      COMMON /TVALS/ ISTART,TMAX,TPRIN,TPRPL,TPLOT,TSAVE,TCOMP,TZ       TVALS  2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      DIMENSION TITLE(20), AMAT(21)                                     INITAL17
      EQUIVALENCE (AMAT,AX)                                             INITAL18
      EQUIVALENCE(YZ,T0)                                                OFAX   2
      REAL MU                                                           INITAL19
      LOGICAL PDER,ERR                                                  INITAL20
      DATA KT,AKT,DT,ERR/0,0.0,0.0,.FALSE./                             INITAL21
      DATA PI,AX,AY,RDIS,DAL,EPS,EPS1,KMAX/3.141592653,1.0,1.0,0.25,0.25INITAL22
     1,0.00001,0.0001,7/                                                INITAL23
      ETA(Y) = BMAX-ALOG((B+A-Y)/(B-A+Y))*ARL                           INITAL24
      ALP(X,Y) = FACT*(X-ANG*Y+TOP*ATAN(AF*Y))                          INITAL25
      CALL SECOND (TZ)                                                  INITAL26
      READ (5,420) TITLE                                                INITAL27
      WRITE (6,430) TITLE                                               INITAL28
      READ (5,410) TMAX,TPRIN,TPRPL,TPLOT,TSAVE,TCOMP,PORG,PSCL         INITAL29
      READ(5,410) RDIS                                                  INITAL30
      READ (5,390) NMAT,ISTART                                          INITAL31
      READ (5,400) NINFC                                                INITAL32
      NIN6 = 6*NINFC                                                    INITAL33
      READ (5,400) (INFC(I),I = 1,NIN6)                                 INITAL34
      DTMN = 1.0E6                                                      INITAL35
      IF (ISTART.EQ.0) GO TO 10                                         INITAL36
      REWIND 1                                                          INITAL37
      READ (1) KT,AKT,DTMIN                                             INITAL38
      READ (1) NINFC,NIN6,(INFC(I),I = 1,NIN6)                          INITAL39
   10 DO 330 MAT = 1,NMAT                                               INITAL40
      READ(5,390) NI,NJ,IF,IL,JF,JL,NLF,NTF,NRT,NFMAX,NTR,MATNO,IPRINT, OFAX   2
     1JPRINT                                                            OFAX   3
      READ (5,410) ZLEN,YMAX,THETA,CAP,D,VIS,VIST,CFL                   INITAL43
      READ (5,410) MU,YC,RHO,UI                                         INITAL44
      IF (MATNO.GT.0) GO TO 20                                          INITAL45
      MATNO = -MATNO                                                    INITAL46
      READ (5,410) APL(MATNO),BPL(MATNO),APB(MATNO),BPB(MATNO),ALPH(MATNINITAL47
```

```
  10),BETA(MATNO),ES(MATNO),EZERO(MATNO),ESFRM(MATNO),RMIN(MATNO)      INITAL48
   RHOZRO(MATNO) = RHO                                                 INITAL49
20 CONTINUE                                                            INITAL50
   WRITE (6,440) MAT,NI,NJ,IF,IL,JL,ZLEN,YMAX,THETA,CAP,D,VIS,VIST,CFINITAL51
  1L,MU,YC,RHO,UI                                                      INITAL52
   DO 30 I = 1,7                                                       INITAL53
30 IMAT(I,MAT) = 0                                                     INITAL54
   DO 40 M = 1,MAT                                                     INITAL55
   IMAT(4,MAT) = IMAT(4,MAT)+IMAT(1,M)                                 INITAL56
   IMAT(5,MAT) = IMAT(5,MAT)+IMAT(2,M)                                 INITAL57
   IMAT(6,MAT) = IMAT(6,MAT)+(IMAT(1,M)+2)*IMAT(2,M)                   INITAL58
40 IMAT(7,MAT) = IMAT(7,MAT)+IMAT(3,M)                                 INITAL59
   IMAT(1,MAT) = NI                                                    INITAL60
   NJ=NJ+1                                                             INITAL61
   IMAT(2,MAT)=NJ                                                      INITAL62
   IMAT(3,MAT) = NFMAX                                                 INITAL63
   IMAT(10,MAT) = MATNO                                                INITAL64
   IMAT(11,MAT) = IPRINT                                               INITAL65
   IMAT(12,MAT) = JPRINT                                               INITAL66
   NIP2 = NI+2                                                         INITAL67
   IS = IMAT(4,MAT)                                                    INITAL68
   JS = IMAT(5,MAT)                                                    INITAL69
   IJS = IMAT(6,MAT)                                                   INITAL70
   IBS = IMAT(7,MAT)                                                   INITAL71
   DO 60 J = 1,NJ                                                      INITAL72
   JJ=IJS+(J-1)*NIP2                                                   INITAL73
   DO 60 I = 1,NI                                                      INITAL74
   IJ=JJ+I                                                             INITAL75
   DO 50 KK = 1,KMAX                                                   INITAL76
50 W(IJ,KK) = 0.0                                                      INITAL77
60 L(IJ) = 0                                                           INITAL78
   DO 70 I = 1,NFMAX                                                   INITAL79
   FRX(IBS+I) = 0.0                                                    INITAL80
   FRY(IBS+I) = 0.0                                                    INITAL81
   FRS(IBS+I) = 0.0                                                    INITAL82
   DO 70 KK = 1,KMAX                                                   INITAL83
70 WB(IBS+I,KK) = 0.0                                                  INITAL84
   X0 = ZLEN/FLOAT(IL-IF+1)                                            INITAL85
   T0 = X0                                                             INITAL86
   U0 = X0/T0                                                          INITAL87
   P0 = RHO*U0**2                                                      INITAL88
   FACT = 1.0/X0                                                       INITAL89
   ML = MU/P0                                                          INITAL90
   YC = YC/P0                                                          INITAL91
   YC = (YC**2)/3.                                                     INITAL92
   IT1=IBS+1                                                           INITC1 1
   IT2=IBS+NLF                                                         INITC1 2
   READ (5,410) (FRX(I),FRY(I),I=IT1,IT2)                              INITC1 3
   WRITE(6,450) (FRX(I),FRY(I),I=IT1,IT2)                              INITC1 4
   N1 = NLF                                                            INITAL95
   N2 = NLF*NTP-1                                                      INITAL96
   IT1=IBS+N1                                                          INITC1 5
   IT2=IBS+N2                                                          INITC1 6
   READ (5,410) (FRX(I),FRY(I),I=IT1,IT2)                              INITC1 7
   WRITE(6,460) (FRX(I),FRY(I),I=IT1,IT2)                              INITC1 8
   N1 = N2                                                             INITAL99
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      N2 = N2+NRT-1                                                    INITA100
      IT1=IBS+N1                                                       INITC1 .
      IT2=IBS+N2                                                       INITC11
      READ (5,410) (FRX(I),FRY(I),I=IT1,IT2)                           INITC111
      WRITE(6,470) (FRX(I),FRY(I),I=IT1,IT2)                           INITC112
      READ (5,390) (ITR(MAT,I),I = 1,NTR)                              INITA103
      DO 80 I = 1,NTR                                                  INITA104
      TRS(MAT,I) = 0.0                                                 INITA105
      J = ITR(MAT,I)                                                   INITA106
      TFRX(I) = FRX(IBS+J)                                             INITA107
      TFRY(I) = FRY(IBS+J)                                             INITA108
      IF (J.NE.N2) GO TO 80                                            INITA109
      ITR(MAT,I) = J-1                                                 INITA110
      TRS(MAT,I) = 1.0                                                 INITA111
   80 CONTINUE                                                         INITA112
      WRITE (6,480) (I,TFRX(I),TFRY(I),I = 1,NTR)                      INITA113
      IF (ISTART.EQ.0) GO TO 100                                       INITA114
      READ (1) (NBEG(MAT,I),NEND(MAT,I),ARCSIZ(MAT,I),I = 1,3),XZ,MI,MJ,INITA115
     1NF,YZ                                                            OFAX   4
      IT1=IBS+1                                                        INITC113
      IT2=IBS+NF                                                       INITC114
      READ(1) ((WB(I,KK),KK=1,KMAX),FRS(I),I=IT1,IT2),(FRX(I),FRY(I),  INITC115
     1I=IT1,IT2),DTM                                                   INITC116
      READ (1) NTR,(ITR(MAT,I),TRS(MAT,I),I = 1,NTR)                   INITA119
      IDF = IF-1                                                       INITA120
      I2 = MI+IDF                                                      INITA121
      JDF=JF-1                                                         OFAX   5
      J2=MJ+JDF                                                        OFAX   6
      DO 85 J=JF,J2                                                    OFAX   7
      JJ=IJS+(J-1)*NIP2                                                INITC118
      IT1=JJ+IF                                                        INITC119
      IT2=JJ+I2                                                        INITC120
   85 READ(1) ((W(I,KK),KK=1,KMAX),L(I),I=IT1,IT2)                     INITC121
      NC = NEND(MAT,1)                                                 INITA124
      NE = NEND(MAT,2)                                                 INITA125
      ZDF = FLOAT(IDF)*AX                                              INITA126
      XZ = XZ+ZDF                                                      INITA127
      RDF=FLOAT(JDF)*AY                                                OFAX   8
      YZ=YZ+RDF                                                        OFAX   9
      DO 90 I = 1,NF                                                   INITA128
      FRY(IBS+I)=FRY(IBS+I)+RDF                                        OFAX  10
   90 FRX(IBS+I) = FRX(IBS+I)+ZDF                                      INITA129
  100 CONTINUE                                                         INITA130
      THET = THETA*PI/180.                                             INITA131
      BMAX=FLOAT(JL-JF+1)                                              OFAX  11
      Y0 = YMAX/(BMAX-0.5)                                             INITA133
      ANG = 1./TAN(THET)                                               INITA134
      CFL=CFL+X0                                                       OFAX  12
      AF = 1.0/CAP                                                     INITA136
      TOP = 2./PI                                                      INITA137
      A = Y0*BMAX                                                      INITA138
      B = A/(1.-D/A)                                                   INITA139
      ARL = BMAX/ALOG((B+A)/(B-A))                                     INITA140
      DARL = 1./(2.*B*ARL)                                             INITA141
      CHAN = ((B+A)/(B-A))**(1.0/BMAX)                                 INITA142
      IF(ISTART.NE.0) GO TO 115                                        INITA143
```

```
      ZMIN = 1.0E10                                                    INITA144
      RMIN=ZMIN                                                        OFAX  13
      DO 105 I=1,N2                                                    INITA145
      ZZ = FRX(IBS+I)                                                  INITA146
      RR = FRY(IBS+I)                                                  INITA147
      ZMIN = AMIN1(ZMIN,ZZ)                                            INITA148
      RMIN=AMIN1(RMIN,RR)                                              OFAX  14
      FRX(IBS+I) = ALP(ZZ,RR)                                          INITA149
  105 FRY(IBS+I) = ETA(RR)                                             INITA150
      XZ = (FLOAT(IF)-1.5)*AX-FACT*ZMIN                                INITA151
      FRX(IBS+1) = FRX(IBS+1)+XZ                                       INITA152
      YZ=(FLOAT(JF)-1.5)*AY-ETA(RMIN)                                  OFAX  15
      IF(JF.EQ.1) YZ=0.0                                               OFAX  16
      FRY(IBS+1)=FRY(IBS+1)+YZ                                         OFAX  17
      DO 110 I=2,N2                                                    INITA153
      FRX(IBS+I) = FRX(IBS+I)+XZ                                       INITA154
      FRY(IBS+I)=FRY(IBS+I)+YZ                                         OFAX  18
  110 FRS(IBS+I) = FRS(IBS+I-1)+SQRT((FRY(IBS+I)-FRY(IBS+I-1))**2+     INITA155
     1(FRX(IBS+I)-FRX(IBS+I-1))**2)                                    INITA156
      ND = 2.0*FRS(IBS+NLF)+1.5                                        INITA157
      N1 = NLF*NTP-1                                                   INITA158
      NE = 2.0*FRS(IBS+N1)+1.5                                         INITA159
      NF = 2.0*FRS(IBS+N2)+1.5                                         INITA160
      NBEG(MAT,1) = 1                                                  INITA161
      NBEG(MAT,2) = ND                                                 INITA162
      NBEG(MAT,3) = NE                                                 INITA163
      NEND(MAT,1) = ND                                                 INITA164
      NEND(MAT,2) = NE                                                 INITA165
      NEND(MAT,3) = NF                                                 INITA166
  115 CONTINUE                                                         INITA167
      DO 120 I = 1,21                                                  INITA168
  120 FMAT(I,MAT) = AMAT(I)                                            INITA169
      FMAT(22,MAT) = 1.0                                               INITA170
      NTRS(MAT) = NTP                                                  INITA171
      CALL GENVAL                                                      INITA172
      DO 130 J = 2,NJ                                                  INITA173
      AJ=AY*FLOAT(J-2)+YZ                                              OFAX  19
      CH = CHAN**(BMAX*AJ)                                             INITA175
      Y(JS+J) = A-B*(CH-1.)/(CH+1.)                                    INITA176
      YSE(JS+J) = FACT*(B**2-(A-Y(JS+J))**2)*DARL                      INITA177
      ESY(JS+J) = 1./YSE(JS+J)                                         INITA178
      AFY = AF*Y(JS+J)                                                 INITA179
      AFY2 = AFY**2                                                    INITA180
      ASY(JS+J) = ANG*TOP*(ATAN(AFY)+AFY/(1.+AFY2))                    INITA181
      AYY(JS+J) = X0*2.*ANG*TOP*AF*YSE(JS+J)*(1.-AFY2/(1.+AFY2))/(1.+AFY INITA182
     12)                                                               INITA183
      ESYE(JS+J) = -2.*DARL*(A-Y(JS+J))*ESY(JS+J)                      INITA184
      EIGF(JS+J) = SQRT(ASY(JS+J)**2+1.)                               INITA185
      IF (J.GT.2) DY(JS+J) = X0*YSE(JS+J)/Y(JS+J)                      INITA186
      IF (J.EQ.2) DY(JS+J) = 1.                                        INITA187
  130 CONTINUE                                                         INITA188
      Y(JS+1) = -Y(JS+3)                                               INITA189
      YSE(JS+1) = YSE(JS+3)                                            INITA190
      ESY(JS+1) = 1./YSE(JS+1)                                         INITA191
      ASY(JS+1) = -ASY(JS+3)                                           INITA192
      DY(JS+1) = -DY(JS+3)                                             INITA193
```

```
      DO 140 J = 2,NJM1                                                 INITA194
      AJ=AY*(FLOAT(J)-1.5)-YZ                                           OFAX  20
      CH = CHAN**(BMAX-AJ)                                              INITA196
      YY = A-B*(CH-1.)/(CH+1.)                                          INITA197
      YSEA(JS+J) = .5*(YSF(JS+J)+YSE(JS+J+1))                           INITA198
      ESYA(JS+J) = 1./YSEA(JS+J)                                        INITA199
      ASYA(JS+J) = ANG*TOP*(ATAN(AF*YY)+AF*YY/(1.+(AF*YY)**2))          INITA200
      DYA(JS+J) = X0*YSEA(JS+J)/YY                                      INITA201
  140 CONTINUE                                                          INITA202
      YSEA(JS+1) = YSEA(JS+2)                                           INITA203
      ESYA(JS+1) = ESYA(JS+2)                                           INITA204
      ASYA(JS+1) = -ASYA(JS+2)                                          INITA205
      DYA(JS+1) = -DYA(JS+2)                                            INITA206
      IF (ISTART.NE.0) GO TO 260                                        INITA207
      DO 240 M = 1,3                                                    INITA208
      LB = NBEG(MAT,M)                                                  INITA209
      GO TO (170,180,190), M                                            INITA210
  170 LF = NLF                                                          INITA211
      GO TO 200                                                         INITA212
  180 LF = LB+NTP-1                                                     INITA213
      GO TO 200                                                         INITA214
  190 LF = LB+NRT-1                                                     INITA215
  200 LADD = NEND(MAT,M)-LF                                             INITA216
      LM = N2-LF                                                        INITA217
      IF (LM.EQ.0) GO TO 240                                            INITA218
      DO 210 I = 1,NTR                                                  INITA219
      IF (ITR(MAT,I).LT.LF) GO TO 210                                   INITA220
      ITR(MAT,I) = ITR(MAT,I)+LADD                                      INITA221
  210 CONTINUE                                                          INITA222
      NIN2 = 2*NINFC                                                    INITA223
      DO 220 I = 1,NIN2                                                 INITA224
      IF (INFC(3*I-2).NE.MAT) GO TO 220                                 INITA225
      IF (INFC(3*I-1).GE.LF) INFC(3*I-1) = INFC(3*I-1)+LADD             INITA226
      IF (INFC(3*I).GE.LF) INFC(3*I) = INFC(3*I)+LADD                   INITA227
  220 CONTINUE                                                          INITA228
      NF1 = N2+1                                                        INITA229
      DO 230 LL = 1,LM                                                  INITA230
      L1 = NF1-LL                                                       INITA231
      L2 = L1+LADD                                                      INITA232
      FRX(IRS+L2) = FRX(IRS+L1)                                         INITA233
      FRY(IRS+L2) = FRY(IRS+L1)                                         INITA234
  230 CONTINUE                                                          INITA235
      N2 = N2+LADD                                                      INITA236
  240 CALL RELABL (M)                                                   INITA237
      DO 250 I = 1,NF                                                   INITA238
      WB(IRS+I,1) = 1.0                                                 INITA239
      WB(IRS+I,4) = 0.0                                                 INITA240
  250 WB(IRS+I,2) = UI                                                  INITA241
  260 CALL BPOSN                                                        INITA242
      CALL BVALU                                                        INITA243
      IF (ISTART.NE.0) GO TO 320                                        INITA244
      DO 280 J = 2,NJ                                                   INITA245
      JJ=IJS+(J-1)*NIP2                                                 INITA246
      DO 280 I = 1,NI                                                   INITA247
      IJ=JJ+I                                                           INITA248
      W(IJ,1) = 1.0                                                     INITA249
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      W(IJ,2) = UI                                                      INITA250
      DO 270 KK = 3,KMAX                                                INITA251
  270 W(IJ,KK) = 0.0                                                    INITA252
      L(IJ) = 1                                                         INITA253
  280 CONTINUE                                                          INITA254
      CALL IPOSN                                                        INITA255
      DO 290 I = 1,NI                                                   INITA256
      W(IJS+I,1) = W(IJS+2*NIP2+I,1)                                    INITA257
      W(IJS+I,2) = W(IJS+2*NIP2+I,2)                                    INITA258
      W(IJS+I,3) = -W(IJS+2*NIP2+I,3)                                   INITA259
  290 L(IJS+I) = L(IJS+2*NIP2+I)                                        INITA260
      SBM = 0.0                                                         INITA261
      PDER = .TRUE.                                                     INITA262
      DO 300 J = 2,NJ                                                   INITA263
      JJ=IJS+(J-1)*NIP2                                                 INITA264
      DO 300 I = 1,NI                                                   INITA265
      IJ=JJ+I                                                           INITA266
      IF(L(IJ).EQ.0) GO TO 300                                          INITC122
      RHO = W(IJ,1)                                                     INITA267
      E = W(IJ,4)                                                       INITA268
      P = PRS(RHO,E)                                                    INITA269
      C2 = PR*P*PE/RHO**2                                               INITA270
      C = SQRT(C2)                                                      INITA271
      UC = (ABS(W(IJ,2)-ASY(JS+J)*W(IJ,3))+EIGF(JS+J)*C)*DAX            INITA272
      VC = (ABS(W(IJ,3))+C)*ESY(JS+I)*DAY                               INITA273
      SB = AMAX1(UC,VC)                                                 INITA274
      IF (SB.LE.SBM) GO TO 300                                          INITA275
      SBM = SB                                                          INITA276
      ISB = I                                                           INITA277
      JSB = J                                                           INITA278
  300 CONTINUE                                                          INITA279
      DO 310 M = 1,3                                                    INITA280
      NNB = NBEG(MAT,M)                                                 INITA281
      NNF = NEND(MAT,M)                                                 INITA282
  310 ARCSIZ(MAT,M) = FRS(IBS+NNF)-FRS(IBS+NNB)                         INITA283
      DTM = CFL/SBM                                                     INITA284
      DTMN = AMIN1(DTM,DTMN)                                            INITA285
  320 FMAT(22,MAT) = DTM                                                INITA286
      IMAT(8,MAT) = ISB                                                 INITA287
      IMAT(9,MAT) = JSB                                                 INITA288
  330 CONTINUE                                                          INITA289
      IF (ISTART.EQ.0) DTMIN = 0.05*DTMN                                INITA290
      IF (TSAVE.LT.0.0) TSAVE = 1.0E8                                   INITA291
      IF (TPRPL.GE.0.0) GO TO 340                                       INITA292
      TPRPL = 1.0E8                                                     INITA293
      GO TO 350                                                         INITA294
  340 CALL PRNTS (999,TITLE)                                            INITA295
      CALL PRNPLT                                                       INITA296
  350 IF (TPLOT.GE.0.0) GO TO 360                                       INITA297
      TPLOT = 1.0E8                                                     INITA298
      GO TO 370                                                         INITA299
  360 CALL PLTOUT                                                       INITA300
  370 IF (TPRIN.GE.0.0) GO TO 380                                       INITA301
      TPRIN = 1.0E8                                                     INITA302
      RETURN                                                            INITA303
  380 CALL OUTPUT                                                       INITA304
```

```
      RETURN                                                            INITA305
C                                                                       INITA306
  390 FORMAT (16I5)                                                     INITA307
  400 FORMAT (12I5)                                                     INITA308
  410 FORMAT (8E10.3)                                                   INITA309
  420 FORMAT (20A4)                                                     INITA310
  430 FORMAT (1H1/1H020A4)                                              INITA311
  440 FORMAT (1H0//58X8HMATERIAL I2/5X19HMAXIMUM ALPHA MESH=I4,17X18HMAXIINITA312
     1MUM BETA MESH=I4,18X28HINITIAL LEFTMOST ALPHA LINE=I4/5X29HINITIALINITA313
     2 RIGHTMOST ALPHA LINE=I4,7X26HINITIAL TOPMOST BETA LINE=I4,10X27HIINITA314
     3NITIAL MATERIAL THICKNESS=F7.3/5X24HINITIAL MATERIAL HEIGHT=F8.3,8INITA315
     4X15HMATERIAL ANGLE=F7.2,18X11HCAP LENGTH=F9.5/5X25HBOUNDARY LAYER INITA316
     5THICKNESS=F8.3,7X30HONESTEP VISCOSITY COEFFICIENT=F6.4,4X30HTWOSTEINITA317
     6P VISCOSITY COEFFICIENT=F6.4/5X17HTIME STEP FACTOR=F5.3,18X14HSHEAINITA318
     7R MODULUS=F9.5,17X16HYIELD CONDITION=F9.5/5X25HINITIAL MATERIAL DEINITA319
     8NSITY=F7.3,8X26HINITIAL MATERIAL VELOCITY=F9.6)                   INITA320
  450 FORMAT (1H041X47HINITIAL (Z,R) COORDINATES OF LEFT MATERIAL FACE/(INITA321
     15(/X,2F9.5)))                                                     INITA322
  460 FORMAT (1H041X46HINITIAL (Z,R) COORDINATES OF TOP MATERIAL FACE/(5INITA323
     1(7X,2F9.5)))                                                      INITA324
  470 FORMAT (1H040X48HINITIAL (Z,R) COORDINATES OF RIGHT MATERIAL FACE/INITA325
     1(5(7X,2F9.5)))                                                    INITA326
  480 FORMAT (1H043X45HINITIAL (Z,R) COORDINATES OF TRACER PARTICLES/(5(INITA327
     14X,I2,1H),2F9.5)))                                                INITA328
      END                                                               INITA329
```

```
      SUBROUTINE GENVAL                                                 GENVAL  2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR  2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
                                                                        ZONES  3
     15,3)
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT  2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL  2
                                                                        COMVAL  3
     1S,TOP,DAL,KMAX,PORG,PSCL,LB,LF
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,X0,P0,T0,XZ,A,B,ABL,DMATVAL  2
     1ARL,CHAN,BMAX,FACT,ANG,AF,SHM,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,DAXMATVAL  3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,FRTDMU,ODVMMATVAL  4
     3U,TREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISR,JSR,NIM1,NJM1,ND,ND1,NF,NE1MATVAL  5
                                                                        MATVAL  6
     4,NF,NIP2,NTR
      COMMON /PRESS/ PUER,PR,PE,MATNO                                   PRESS  2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      DIMENSION AMAT(21), MMAT(7)                                       GENVAL10
      EQUIVALENCE (AMAT,AX), (MMAT,NI)                                  GENVAL11
      REAL MU                                                           GENVAL12
      DO 10 I = 1,21                                                    GENVAL13
   10 AMAT(I) = FMAT(I,MAT)                                             GENVAL14
      DO 20 I = 1,7                                                     GENVAL15
   20 MMAT(I) = IMAT(I,MAT)                                             GENVAL16
      MATNO = IMAT(10,MAT)                                              GENVAL17
      DAX = 1.0/AX                                                      GENVAL18
      DAY = 1.0/AY                                                      GENVAL19
      HDAX = 0.5*DAX                                                    GENVAL20
      HDAY = 0.5*DAY                                                    GENVAL21
      DAX2 = DAX**2                                                     GENVAL22
      DAY2 = DAY**2                                                     GENVAL23
      HDAXY = 0.5*DAX*DAY                                               GENVAL24
      QDAXY = 0.5*HDAXY                                                 GENVAL25
      HALFMU = 0.5*MU                                                   GENVAL26
      TWTDMU = 2.0*MU/3.0                                               GENVAL27
      FRTDMU = 2.0*TWTDMU                                               GENVAL28
      DDVMU = 1.0/MU                                                    GENVAL29
      TREOTM = 3.0/(2.0*MU)                                             GENVAL30
      AK=FACT*DT                                                        DFAX  21
      AL = AK*DAX                                                       GENVAL33
      AS = AK*DAY                                                       GENVAL34
      HAL = 0.5*AL                                                      GENVAL35
      HAS = 0.5*AS                                                      GENVAL36
      HAK = 0.5*AK                                                      GENVAL37
      QAL = 0.25*AL                                                     GENVAL38
      QAS = 0.25*AS                                                     GENVAL39
      QAK = 0.25*AK                                                     GENVAL40
      NIP2 = NI+2                                                       GENVAL41
      NIM1 = NI-1                                                       GENVAL42
      NJM1 = NJ-1                                                       GENVAL43
      ND = NEND(MAT,1)                                                  GENVAL44
      NE = NEND(MAT,2)                                                  GENVAL45
      NF = NEND(MAT,3)                                                  GENVAL46
      ND1 = ND+1                                                        GENVAL47
      NE1 = NE+1                                                        GENVAL48
      NTR = NTRS(MAT)                                                   GENVAL49
      RETURN                                                            GENVAL50
      END                                                               GENVAL51
```

```
      SUBROUTINE MVBND                                                  MVBND  2
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FR3(600)             BNDVAL 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                   MATARR 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,CAL,KMAX,PURG,PSCL,LB,LF                                   COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,XJ,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ARL,CHAN,BMAX,FACT,ANG,AF,SRM,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,QAXMATVAL 3
     2,QAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMJ,TWTDMU,FRTDMU,QOVMMATVAL 4
     3U,TRLOTH,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISR,JSR,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                     MATVAL 6
      EQUIVALENCE(YZ,TU)                                                QFAX  22
      DO 10 MAT = 1,NMAT                                                MVBND  7
      CALL GENVAL                                                       MVBND  8
      N1 = IBS+1                                                        MVBND  9
      N2 = IBS+NF                                                       MVBND 10
      DO 10 I = N1,N2                                                   MVBND 11
      CH=CHAN**(BMAX*FRY(I)*YZ)                                         QFAX  23
      RH = A-B*(CH-1.0)/(CH+1.0)                                        MVBND 13
      ZR = XU*(FRX(I)-XZ)*ANG*RH*TOP*ATAN(AF*RH)                        MVBND 14
      FRX(I) = ZR+DT*WB(I,2)                                            MVBND 15
      FRY(I) = AMAX1(RH*DT*WB(I,3),0.0)                                 MVBNDC11
      WB(I,1) = FRY(I)                                                  MVBND 17
   10 CONTINUE                                                          MVBND 18
      RETURN                                                            MVBND 19
      END
```

```
      SUBROUTINE ADJINT                                                 ADJINT 2
      COMMON /BNDVAL/ BR(400,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),AREASIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON/SCRTCH/ TBR(300,7),TFRX(300),TFRY(300)                     SCRTCH 2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIPP,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,POPG,PSCL,LB,LF                                    COMVAL 3
      LOGICAL ERR                                                       ADJINT 4
      DO 80 I = 1,NINFC                                                 ADJINT10
      MAT1 = INFC(6*I-5)                                                ADJINT11
      MAT2 = INFC(6*I-2)                                                ADJINT12
      IBS1 = IMAT(7,MAT1)                                               ADJINT13
      IBS2 = IMAT(7,MAT2)                                               ADJINT14
      IF(MAT2.EQ.3) GO TO 30                                            ADJINT15
      N1 = IBS1+1                                                       ADJINT16
      N2 = IBS1+NEND(MAT1,3)                                            ADJINT17
      M1=IBS2+NEND(MAT2,2)                                              ADJINT18
      M2=IBS2+NEND(MAT2,3)                                              ADJINT19
      ZMX2=0.0                                                          ADJINT20
      DO 2 J=M1,M2                                                      ADJINT21
    2 ZMX2=AMAX1(FRX(J),ZMX2)                                           ADJINT22
      K=N1                                                              ADJINT23
      DO 4 J=N1,N2                                                      ADJINT24
      IF(FRX(J).GT.ZMX2) GO TO 4                                        ADJINT25
      K=J                                                               ADJINT26
    4 CONTINUE                                                          ADJINT27
      N2=MIN0(K+1,N2)                                                   ADJINT28
      RMX1=0.0                                                          ADJINT29
      DO 5 J=N1,N2                                                      ADJINT30
    5 RMX1=AMAX1(FRY(J),RMX1)                                           ADJINT31
      DO 6 K=M1,M2                                                      ADJINT32
      IF(FRY(K).LE.RMX1) GO TO 8                                        ADJINT33
    6 CONTINUE                                                          ADJINT34
    7 K=K+1                                                             ADJINT35
    8 RMX2=AMAX1(FRY(K+1),FRY(K))                                       ADJINT36
      RMN2=AMIN1(FRY(K+1),FRY(K))                                       ADJINT37
      ZMX2=AMAX1(FRX(K+1),FRX(K))                                       ADJINT38
      ZMN2=AMIN1(FRX(K+1),FRX(K))                                       ADJINT39
      DO 10 J=N1,N2                                                     ADJINT40
      IF(FRY(J).GE.RMN2.AND.FRX(J).GE.ZMN2) GO TO 11                    ADJINT41
   10 CONTINUE                                                          ADJINT42
      GO TO 7                                                           ADJINT43
   11 J1=MAX0(J,IBS1+2)                                                 ADJINT44
      J2=J1-1                                                           ADJINT45
      DO 12 J=J1,N2                                                     ADJINT46
      IF(FRY(J).LT.RMN2.OR.FRX(J).GT.ZMX2) GO TO 12                     ADJINT47
      J2=J                                                              ADJINT48
   12 CONTINUE                                                          ADJINT49
      J2=MIN0(J2+1,N2)                                                  ADJINT50
      D=FRY(K)-FRY(K-1)                                                 ADJINT51
      IF(ABS(D).LE.1.0E-10) D=1.0E-10                                   ADJINT52
      EM2=(FRX(K)-FRX(K-1))/D                                           ADJINT53
      IF(ABS(EM2).LE.1.0) GO TO 14                                      ADJINT54
      EM2=1.0/EM2                                                       ADJINT55
```

```
      B2=FRY(K-1)-EM2*FRX(K-1)                                          ADJINT56
      IEQ=2                                                             ADJINT57
      GO TO 15                                                          ADJINT58
   14 B2=FRX(K-1)-EM2*FRY(K-1)                                          ADJINT59
      IEQ=1                                                             ADJINT60
   15 J=J2+1                                                            ADJINT61
      DO 2? JJ=J1,J2                                                    ADJINT62
      J=J-1                                                             ADJINT63
      D=FRX(J)-FRX(J-1)                                                 ADJINT64
      IF(ABS(D).LE.1.0E-10) D=1.0E-10                                   ADJINT65
      EM1=(FRY(J)-FRY(J-1))/D                                           ADJINT66
      IF(ABS(EM1).LE.1.0) GO TO 18                                      ADJINT67
      EM1=1.0/EM1                                                       ADJINT68
      B1=FRX(J-1)-EM1*FRY(J-1)                                          ADJINT69
      IE=IEQ+2                                                          ADJINT70
      GO TO 20                                                          ADJINT71
   18 B1=FRY(J-1)-EM1*FRX(J-1)                                          ADJINT72
      IE=IEQ                                                            ADJINT73
   20 GO TO (21,22,23,24),IE                                            ADJINT74
   21 R=(B1+EM1*B2)/(1.0+EM1*EM2)                                       ADJINT75
      GO TO 25                                                          ADJINT76
   22 R=(EM2*B1-EM1*B2)/(EM2-EM1)                                       ADJINT77
      GO TO 25                                                          ADJINT78
   23 R=(B1-B2)/(EM2-EM1)                                               ADJINT79
      GO TO 25                                                          ADJINT80
   24 R=(EM2*B1+B2)/(1.0+EM1*EM2)                                       ADJINT81
   25 IF(R.GE.RMN2.AND.R.LE.RMX2) GO TO 40                              ADJINT82
   28 CONTINUE                                                          ADJINT83
      GO TO 7                                                           ADJINT84
   30 N1=IBS1+INFC(6*I+4)                                               ADJINT85
      N2=IBS1+INFC(6*I+3)                                               ADJINT86
      M1=IBS2+INFC(6*I)                                                 ADJINT87
      M2=IBS2+INFC(6*I+1)                                               ADJINT88
      M3=INFC(6*I-1)+1                                                  ADJINT89
      M4=NEND(MAT2,3)                                                   ADJINT90
      LADD=N2-N1-M2+M1                                                  ADJINT91
      NF=M4+LADD                                                        ADJINT92
      IF(NF.GT.IMAT(3,MAT2)) GO TO 55                                   ADJINT93
      DO 32 J=M3,M4                                                     ADJINT94
      K=IBS2+J                                                          ADJINT95
      TFRX(J)=FRX(K)                                                    ADJINT96
   32 TFRY(J)=FRY(K)                                                    ADJINT97
      M5=M2+LADD                                                        ADJINT98
      J=N2+1                                                            ADJINT99
      DO 34 K=M1,M5                                                     ADJIN100
      J=J-1                                                             ADJIN101
      FRX(K)=FRX(J)                                                     ADJIN102
   34 FRY(K)=FRY(J)                                                     ADJIN103
      K=M5                                                              ADJIN104
      DO 36 J=M3,M4                                                     ADJIN105
      K=K+1                                                             ADJIN106
      FRX(K)=TFRX(J)                                                    ADJIN107
   36 FRY(K)=TFRY(J)                                                    ADJIN108
      M2=M2-IBS2                                                        ADJIN109
      INFC(6*I-1)=M2+LADD                                               ADJIN110
      NEND(MAT2,3)=NF                                                   ADJIN111
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```
      IF(NEND(MAT2,2).LT.M2) GO TO 80                                   ADJIN112
      NEND(MAT2,2)=NEND(MAT2,2)+LADD                                    ADJIN113
      NBEG(MAT2,3)=NBEG(MAT2,3)+LADD                                    ADJIN114
      IF(NEND(MAT2,1).LT.M2) GO TO 80                                   ADJIN115
      NEND(MAT2,1)=NEND(MAT2,1)+LADD                                    ADJIN116
      NBEG(MAT2,2)=NBEG(MAT2,2)+LADD                                    ADJIN117
      GO TO 80                                                          ADJIN118
   40 NINT = J-1                                                        ADJIN119
   50 CONTINUE                                                          ADJIN120
      INFC(6*I-3) = NINT-IBS1                                           ADJIN121
      INFC(6*I) = K-IBS2                                                ADJIN122
      NF = INFC(6*I)+INFC(6*I-3)-1                                      ADJIN123
      IF (NF.LE.IMAT(3,MAT2)) GO TO 60                                  ADJIN124
   55 CONTINUE                                                          ADJIN125
      WRITE (6,90) MAT2,MAT1                                            ADJIN126
      ERR = .TRUE.                                                      ADJIN127
      GO TO 80                                                          ADJIN128
   60 NEND(MAT2,3) = NF                                                 ADJIN129
      INFC(6*I-1) = NF                                                  ADJIN130
      K = K+INFC(6*I-3)                                                 ADJIN131
      DO 70 J = N1,NINT                                                 ADJIN132
      K = K+1                                                           ADJIN133
      FRX(K) = FRX(J)                                                   ADJIN134
   70 FRY(K) = FRY(J)                                                   ADJIN135
   80 CONTINUE                                                          ADJIN136
      RETURN                                                            ADJIN137
C                                                                       ADJIN138
   90 FORMAT (41H0TOO MANY POINTS ON INTERFACE OF MATERIAL I2,14H WITH MAADJIN139
     1TERIAL I2)                                                        ADJIN140
      END                                                               ADJIN141
```

```
      SUBROUTINE FDIFF                                                      FDIFF  2
      COMMON// W(2200,7),L(2200)                                            INTVAL 2
      COMMON/MSHFCN/ Y(78),DY(78),DYA(78),ESY(78),YSE(78),ESYA(78),         MSHFCN 2
     1YSEA(78),ESYE(78),EIGF(78),ASY(78),AYY(78),ASYA(78)                   MSHFCN 3
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                        MATARR 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDI    COMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                        COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBM,AL,AS,AK,HAL,HAS,HAY,GAL,GAS,GAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,GDAXY,DTR,HALFMU,TWTOMU,FRTOMU,OOVMMATVAL 4
     3U,IREGTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISR,JSR,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                          MATVAL 6
      COMMON /PRESS/ PDER,PR,PE,MATNO                                       PRESS  2
      REAL MU                                                               FDIFF  9
      LOGICAL PDER,AXIS                                                     FDIFF 10
      DIMENSION WW(3,3,7), F(3,3,7), G(3,3,7), H(3,3,7), T(3,3,3)           FDIFF 11
      DIMENSION WP(2,2,7), WN(7)                                            FDIFF 12
      SBM = 0.0                                                             FDIFF 13
      NIP1 = NI+1                                                           FDIFF 14
      DO 10 I = 1,NI                                                        FDIFF 15
      M = NIP1-I                                                            FDIFF 16
      DO 10 N = 1,NJ                                                        FDIFF 17
      MN = IJS+(N-1)*NIP2+M                                                 FDIFF 18
      L(MN+2) = L(MN)                                                       FDIFF 19
      DO 10 K = 1,KMAX                                                      FDIFF 20
      W(MN+2,K) = W(MN,K)                                                   FDIFF 21
   10 CONTINUE                                                              FDIFF 22
      DO 260 M = 4,NIP1                                                     FDIFF 23
      DO 260 N = 2,NJM1                                                     FDIFF 24
      MN = IJS+(N-1)*NIP2+M                                                 FDIFF 25
      IF (L(MN).EQ.0) GO TO 260                                             FDIFF 26
      NEIBR = 0                                                             FDIFF 27
      IF (L(MN+1).EQ.0) NEIBR = NEIBR+1                                     FDIFF 28
      IF (L(MN+NIP2).EQ.0) NEIBR = NEIBR+2                                  FDIFF 29
      IF (L(MN-1).EQ.0) NEIBR = NEIBR+4                                     FDIFF 30
      IF (L(MN-NIP2).EQ.0) NEIBR = NEIBR+8                                  FDIFF 31
      IF (L(MN+NIP2+1).EQ.0) NEIBR = NEIBR+16                               FDIFF 32
      IF (L(MN+NIP2-1).EQ.0) NEIBR = NEIBR+32                               FDIFF 33
      IF (L(MN-NIP2-1).EQ.0) NEIBR = NEIBR+64                               FDIFF 34
      IF (L(MN-NIP2+1).EQ.0) NEIBR = NEIBR+128                              FDIFF 35
      IF (NEIBR.NE.0) GO TO 210                                             FDIFF 36
      MM2 = M-2                                                             FDIFF 37
      NM2 = N-2                                                             FDIFF 38
      AXIS = .FALSE.                                                        FDIFF 39
      IF (N.EQ.2) AXIS = .TRUE.                                             FDIFF 40
      ESYN = ESY(JS+N)                                                      FDIFF 41
      DJ1 = DY(JS+N)*DAK                                                    FDIFF 42
      DJ2 = .5*DJ1                                                          FDIFF 43
      PDER = .FALSE.                                                        FDIFF 44
      DO 20 J = 1,3                                                         FDIFF 45
      MJ = NM2+J                                                            FDIFF 46
      YSEJ = YSE(JS+MJ)                                                     FDIFF 47
      AR = -ASY(JS+MJ)                                                      FDIFF 48
      JJ=IJS+(MJ-1)*NIP2                                                    FDIFF 49
      DO 20 I = 1,3                                                         FDIFF 50
      MI = MM2+I                                                            FDIFF 51
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                                                                      FDIFF 52
      IJ=JJ*MI                                                        FDIFF 53
      RHO = W(IJ,1)                                                   FDIFF 54
      U = W(IJ,2)                                                     FDIFF 55
      V = W(IJ,3)                                                     FDIFF 56
      E = W(IJ,4)                                                     FDIFF 57
      S11 = W(IJ,5)                                                   FDIFF 58
      S12 = W(IJ,6)                                                   FDIFF 59
      S22 = W(IJ,7)                                                   FDIFF 60
      P = PRS(RHO,E)                                                  FDIFF 61
      WW(I,J,1) = RHO*YSEJ                                            FDIFF 62
      WW(I,J,2) = WW(I,J,1)*U                                         FDIFF 63
      WW(I,J,3) = WW(I,J,1)*V                                         FDIFF 64
      WW(I,J,4) = WW(I,J,1)*(E+0.5*(U*U+V*V))                         FDIFF 65
      WW(I,J,5) = S11*YSEJ                                            FDIFF 66
      WW(I,J,6) = S12*YSEJ                                            FDIFF 67
      WW(I,J,7) = S22*YSEJ                                            FDIFF 68
      E = WW(I,J,4)/YSEJ                                              FDIFF 69
      F(I,J,1) = WW(I,J,2)+AR*WW(I,J,3)                               FDIFF 70
      F(I,J,2) = F(I,J,1)*U-YSEJ*(S11-P+AR*S12)                       FDIFF 71
      F(I,J,3) = F(I,J,1)*V+YSEJ*((P-S22)*AR-S12)                     FDIFF 72
      F(I,J,4) = YSEJ*((E+P)*(U+AR*V)-S12*(V+AR*U)-S11*U-AR*S22*V)    FDIFF 73
      F(I,J,5) = TWTDMU*(2.*U-AR*V)*YSEJ                              FDIFF 74
      F(I,J,6) = MU*(U+AR*V)*YSEJ                                     FDIFF 75
      F(I,J,7) = TWTDMU*(2.*AR*V-U)*YSEJ                              FDIFF 76
      H(I,J,1) = RHO*V                                                FDIFF 77
      H(I,J,2) = H(I,J,1)*U-S12                                       FDIFF 78
      H(I,J,3) = H(I,J,1)*V-2.*S22-S11                                FDIFF 79
      H(I,J,4) = (E+P-S22)*V-U*S12                                    FDIFF 80
      H(I,J,5) = TWTDMU*V                                             FDIFF 81
      H(I,J,6) = 0.                                                   FDIFF 82
      H(I,J,7) = H(I,J,5)                                             FDIFF 83
      G(I,J,1) = H(I,J,1)                                             FDIFF 84
      G(I,J,2) = H(I,J,2)                                             FDIFF 85
      G(I,J,3) = H(I,J,3)+P+S11+S22                                   FDIFF 86
      G(I,J,4) = H(I,J,4)                                             FDIFF 87
      G(I,J,5) = -TWTDMU*V                                            FDIFF 88
      G(I,J,6) = MU*U                                                 FDIFF 89
      G(I,J,7) = FRTDMU*V                                             FDIFF 90
      T(I,J,1) = S12                                                  FDIFF 91
      T(I,J,2) = -.5*(S11-S22)                                        FDIFF 92
      T(I,J,3) = -S12                                                 FDIFF 93
   20 CONTINUE                                                        FDIFF 94
      AG1X = AL*ABS(F(3,2,1)/WW(3,2,1)-F(2,2,1)/WW(2,2,1))            FDIFF 95
      AG2X = AL*ABS(F(2,2,1)/WW(2,2,1)-F(1,2,1)/WW(1,2,1))            FDIFF 96
      AG1Y = AS*ABS(ESY(JS+N+1)*WW(2,3,3)/WW(2,3,1)-ESYN*WW(2,2,3)/WW(2,FDIFF 97
     12,1))
      AG2Y = AS*ABS(ESYN*WW(2,2,3)/WW(2,2,1)-ESY(JS+N-1)*WW(2,1,3)/WW(2,FDIFF 98
     11,1))                                                           FDIFF 99
      DO 60 K = 1,4                                                   FDIFF100
      DO 30 J = 1,2                                                   FDIFF101
      MJ = NM2*J                                                      FDIFF102
      DJ = DYA(JS+MJ)                                                 FDIFF103
      DO 30 I = 1,2                                                   FDIFF104
   30 WP(I,J,K) = 0.25*(WW(I+1,J+1,K)+WW(I+1,J,K)+WW(I,J+1,K)+WW(I,J,K))FDIFF105
     1+AAS*(G(I+1,J+1,FDIFF106
     1+AAL*(F(I+1,J+1,K)+F(I+1,J,K)-F(I,J,K))+AAS*(G(I+1,J+1,FDIFF106
     2K)-G(I+1,J,K)+G(I,J+1,K)-G(I,J,K))-DAK*DJ*(H(I+1,J+1,K)+H(I+1,J,K)FDIFF107
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     3*H(I,J+1,K)+H(I,J,K))                                                    FDIFF108
      IF (.NOT.AXIS) GO TO 40                                                  FDIFF109
      Q = QAS*(H(2,3,K)-H(2,1,K))                                              FDIFF110
      GO TO 50                                                                 FDIFF111
   40 Q = DJ1*(H(2,3,K)+H(2,1,K))                                              FDIFF112
   50 WN(K) = WW(2,2,K)-QAL*(F(3,2,K)+F(1,2,K))-QAS*(G(2,3,K)+G(2,1,K))-FDIFF113
     1Q+VIST*(AQ1X*(WW(3,2,K)-WW(2,2,K))-AQ2X*(WW(2,2,K)-WW(1,2,K))+AQ1YFDIFF114
     2*(WW(2,3,K)-WW(2,2,K))-AQ2Y*(WW(2,2,K)-WW(2,1,K)))                       FDIFF115
   60 CONTINUE                                                                 FDIFF116
      DO 70 J = 1,2                                                            FDIFF117
      MJ = NM2*J                                                               FDIFF118
      DJ = DYA(JS+MJ)                                                          FDIFF119
      DO 70 I = 1,2                                                            FDIFF120
      MI = MM2+I                                                               FDIFF121
      DIFF = HAL*(OOVMU*(YSE(JS+MJ+1)*ASY(JS+MJ+1)*(G(I+1,J+1,6)-G(I,J+1FDIFF122
     1,6))+YSE(JS+MJ)*ASY(JS+MJ)*(G(I+1,J,6)-G(I,J,6)))+TREOTM*(YSE(JS+MFDIFF123
     2J+1)*(G(I+1,J+1,5)-G(I,J+1,5))+YSE(JS+MJ)*(G(I+1,J,5)-G(I,J,5))))-FDIFF124
     3HAS*OOVMU*(G(I+1,J+1,6)-G(I+1,J,6)+G(I,J+1,6)-G(I,J,6))                  FDIFF125
      CC1 = .25*TREOTM*(ESY(JS+MJ+1)*(F(I+1,J+1,5)+F(I,J+1,5)+F(I+1,J+1,FDIFF126
     17)+F(I,J+1,7))+ESY(JS+MJ)*(F(I+1,J,5)+F(I,J,5)+F(I+1,J,7)+F(I,J,7)FDIFF127
     2))                                                                      FDIFF128
      CC2 = -.25*TREOTM*(G(I+1,J+1,5)+G(I+1,J,5)+G(I,J+1,5)+G(I,J,5))          FDIFF129
      DO 70 K = 5,7                                                            FDIFF130
      TAV = .25*(T(I+1,J+1,K-4)+T(I+1,J,K-4)+T(I,J+1,K-4)+T(I,J,K-4))          FDIFF131
      DIFS = HAS*(ESY(JS+MJ+1)*(WW(I+1,J+1,K)+WW(I,J+1,K))-ESY(JS+MJ)*(WFDIFF132
     1W(I+1,J,K)+WW(I,J,K)))                                                  FDIFF133
      DIFSS = HAL*(WW(I+1,J+1,K)-WW(I,J+1,K)+WW(I+1,J,K)-WW(I,J,K))            FDIFF134
      WP(I,J,K) = .25*(WW(I+1,J+1,K)+WW(I+1,J,K)+WW(I,J+1,K)+WW(I,J,K))+FDIFF135
     1HAL*(F(I+1,J+1,K)-F(I,J+1,K)+F(I+1,J,K)-F(I,J,K))+HAS*(G(I+1,J+1,KFDIFF136
     2)-G(I+1,J,K)+G(I,J+1,K)-G(I,J,K))-CC1*DIFSS-CC2*DIFS-TAV*DIFF-QAK*FDIFF137
     3DJ*(H(I+1,J+1,K)+H(I+1,J,K)+H(I,J+1,K)+H(I,J,K))                         FDIFF138
   70 CONTINUE                                                                 FDIFF139
      DO 100 K = 5,7                                                           FDIFF140
      IF (.NOT.AXIS) GO TO 80                                                  FDIFF141
      Q = QAS*(H(2,3,K)-H(2,1,K))                                              FDIFF142
      GO TO 90                                                                 FDIFF143
   80 Q = DJ1*(H(2,3,K)+H(2,1,K))                                              FDIFF144
   90 WN(K) = WW(2,2,K)+QAL*(F(3,2,K)+F(1,2,K)+(W(MN,2)                        FDIFF145
     1+ASY(JS+N)*W(MN,3))              *(WW(3,2,K)+WW(1,2,K))+T(2,2,K-4)+YSFDIFF146
     2E(JS+N)*(ASY(JS+N)*OOVMU*(G(3,2,6)+G(1,2,6))+TREOTM*(G(3,2,5)+G(1,FDIFF147
     32,5))))+QAS*(G(2,3,K)+G(2,1,K)+W(MN,3)*(ESY(JS+N+1)*                    FDIFF148
     4WW(2,3,K)+ESY(JS+N-1)*WW(2,1,K))+T(2,2,K-4)*(W(MN+NIP2,2)               FDIFF149
     5-W(MN+NIP2,2)))+Q+VIST*(AQ1X*(WW(3,2,K)+WW(2,2,K))+AQ2X*(WW(2          FDIFF150
     6,2,K)+WW(1,2,K))+AQ1Y*(WW(2,3,K)+WW(2,2,K))+AQ2Y*(WW(2,2,K)+WW(2,1FDIFF151
     7,K)))                                                                   FDIFF152
  100 CONTINUE                                                                FDIFF153
      DO 110 J = 1,2                                                           FDIFF154
      MJ = NM2*J                                                               FDIFF155
      AR = -ASYA(JS+MJ)                                                        FDIFF156
      YSEJ = YSEA(JS+MJ)                                                       FDIFF157
      ESYJ = ESYA(JS+MJ)                                                       FDIFF158
      DO 110 I = 1,2                                                           FDIFF159
      RHO = WP(I,J,1)*ESYJ                                                     FDIFF160
      U = WP(I,J,2)/WP(I,J,1)                                                  FDIFF161
      V = WP(I,J,3)/WP(I,J,1)                                                  FDIFF162
      E = WP(I,J,4)/WP(I,J,1)-0.5*(U*U+V*V)                                    FDIFF163
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      S11 = WP(I,J,5)*ESYJ                                                    FDIFF164
      S12 = WP(I,J,6)*ESYJ                                                    FDIFF165
      S22 = WP(I,J,7)*ESYJ                                                    FDIFF166
      P = PRS(RHO,E)                                                          FDIFF167
      E = WP(I,J,4)*ESYJ                                                      FDIFF168
      F(I,J,1) = WP(I,J,2)*AR*WP(I,J,3)                                       FDIFF169
      F(I,J,2) = F(I,J,1)*U-YSEJ*(S11-P*AR*S12)                               FDIFF170
      F(I,J,3) = F(I,J,1)*V+YSEJ*((P-S22)*AR-S12)                             FDIFF171
      F(I,J,4) = YSEJ*((E+P)*(U*AR*V)-S12*(V+AR*U)-S11*U-AR*S22*V)            FDIFF172
      F(I,J,5) = TWTDMJ*(2.*U-AR*V)-YSEJ                                      FDIFF173
      F(I,J,6) = MU*(U+AR*V)*YSEJ                                             FDIFF174
      F(I,J,7) = TWTDMJ*(2.*AR*V-U)+YSEJ                                      FDIFF175
      H(I,J,1) = RHO*V                                                        FDIFF176
      H(I,J,2) = H(I,J,1)*U-S12                                               FDIFF177
      H(I,J,3) = H(I,J,1)*V-2.*S22-S11                                        FDIFF178
      H(I,J,4) = (E+P-S22)*V-U*S12                                            FDIFF179
      H(I,J,5) = TWTDMU*V                                                     FDIFF180
      H(I,J,6) = 0.                                                           FDIFF181
      H(I,J,7) = H(I,J,5)                                                     FDIFF182
      G(I,J,1) = H(I,J,1)                                                     FDIFF183
      G(I,J,2) = H(I,J,2)                                                     FDIFF184
      G(I,J,3) = H(I,J,3)+P+S11+S22                                           FDIFF185
      G(I,J,4) = H(I,J,4)                                                     FDIFF186
      G(I,J,5) = -TWTDMU*V                                                    FDIFF187
      G(I,J,6) = MU*U                                                         FDIFF188
      G(I,J,7) = FRTDMU*V                                                     FDIFF189
      T(I,J,1) = S12                                                          FDIFF190
      T(I,J,2) = -.5*(S11-S22)                                                FDIFF191
      T(I,J,3) = -S12                                                         FDIFF192
  110 CONTINUE                                                                FDIFF193
      DO 140 K = 1,4                                                          FDIFF194
      IF (.NOT.AXIS) GO TO 120                                                FDIFF195
      Q = QAS*(H(2,2,K)-H(2,1,K)+H(1,2,K)-H(1,1,K))                           FDIFF196
      GO TO 130                                                               FDIFF197
  120 Q = DJ2*(H(2,2,K)+H(2,1,K)+H(1,2,K)+H(1,1,K))                           FDIFF198
  130 WN(K) = WN(K)-QAL*(F(2,2,K)-F(1,2,K)+F(2,1,K)-F(1,1,K))+QAS*(G(2,2FDIFF199
     1,K)-G(2,1,K)+G(1,2,K)-G(1,1,K))-Q                                       FDIFF200
  140 CONTINUE                                                                FDIFF201
      DIFF = HAL*(OOVMU*(YSEA(JS+N)*ASYA(JS+N)*(G(2,2,6)+G(1,2,6))+YSEA(FDIFF202
     1JS+N-1)*ASYA(JS+N-1)*(G(2,1,6)-G(1,1,6)))-TREOTM*(YSEA(JS+N)*(G(2,FDIFF203
     22,5)-G(1,2,5))+YSEA(JS+N-1)*(G(2,1,5)-G(1,1,5))))+HAS+OOVMU*(YSEA(FDIFF204
     3JS+N)*(G(2,2,6)+G(1,2,6))-YSEA(JS+N-1)*(G(2,1,6)+G(1,1,6)))         FDIFF205
      CC1 = .25*TREOTM*(ESYA(JS+N)*(F(2,2,5)+F(1,2,5)+F(2,2,7)+F(1,2,7))FDIFF206
     1+ESYA(JS+N-1)*(F(2,1,5)+F(1,1,5)+F(2,1,7)+F(1,1,7)))                    FDIFF207
      CC2 = -.25*TREOTM*(G(2,2,5)+G(2,1,5)+G(1,2,5)+G(1,1,5))                 FDIFF208
      DO 170 K = 5,7                                                          FDIFF209
      TAV = .25*(T(2,2,K-4)+T(1,2,K-4)+T(2,1,K-4)+T(1,1,K-4))                 FDIFF210
      DIFS = QAS*(ESYA(JS+N)*(WP(2,2,K)+WP(1,2,K))-ESYA(JS+N-1)*(WP(2,1,FDIFF211
     1K)+WP(1,1,K)))                                                          FDIFF212
      DIFSS = QAL*(WP(2,2,K)-WP(1,2,K)+WP(2,1,K)-WP(1,1,K))                   FDIFF213
      IF (.NOT.AXIS) GO TO 150                                                FDIFF214
      Q = QAS*(H(2,2,K)-H(2,1,K)+H(1,2,K)-H(1,1,K))                           FDIFF215
      GO TO 160                                                               FDIFF216
  150 Q = DJ2*(H(2,2,K)+H(2,1,K)+H(1,2,K)+H(1,1,K))                           FDIFF217
  160 WN(K) = WN(K)+QAL*(F(2,2,K)-F(1,2,K)+F(2,1,K)-F(1,1,K))+QAS*(G(2,2FDIFF218
     1,K)-G(2,1,K)+G(1,2,K)-G(1,1,K))-CC1*DIFSS-CC2*DIFS+TAV*DIFF-Q       FDIFF219
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```
170 CONTINUE                                                          FDIFF220
    W(MN                -2,1) = WN(1)*ESY(JS*N)                       FDIFF221
    W(MN                -2,2) = WN(2)/WN(1)                           FDIFF222
    W(MN                -2,3) = WN(3)/WN(1)                           FDIFF223
    VEL = W(MN-2,2)**2+W(MN-2,3)**2                                   FDIFF224
    W(MN                -2,4) = AMAX1(WN(4)/WN(1)-0.5*VEL,0.0)        FDIFF225
    W(MN                -2,5) = WN(5)*ESYN                            FDIFF226
    W(MN                -2,6) = WN(6)*ESYN                            FDIFF227
    W(MN                -2,7) = WN(7)*ESYN                            FDIFF228
    YIELD = W(MN-2,5)**2+W(MN-2,7)**2+W(MN-2,6)**2+W(MN-2,5)*W(MN-2,7)FDIFF229
    IF (YIELD.LT.YC) GO TO 200                                        FDIFF230
    IF (AXIS) GO TO 180                                               FDIFF231
    WDOT = ((W(MN,5)-ASY(JS*N)*W(MN,6))*(W(MN+1,2)-W(MN-1,2))+(W(MN,6)FDIFF232
   1-ASY(JS*N)*W(MN,7))*(W(MN+1,3)-W(MN-1,3)))*QAL+ESY(JS*N)*(W(MN,6)*FDIFF233
   2(W(MN+NIP2,2)-W(MN-NIP2,2))+W(MN,7)*(W(MN+NIP2,3)-W(MN-NIP2,3)))*QAFDIFF234
   3S-HAK*(W(MN,5)+W(MN,7))*W(MN,3)*DY(JS*N))                         FDIFF235
    GO TO 190                                                         FDIFF236
180 WDOT = W(MN,5)*((W(MN+1,2)-W(MN-1,2))*QAL-ESY(JS*N)*(W(MN+NIP2,3)-FDIFF237
   1W(MN-NIP2,3)))*QAS)                                               FDIFF238
190 WDOT=AMAX1(WDOT,0.0)                                              FDIFF239
    ACON = WDOT*MU/YC                                                 FDIFF240
    SSQ = (W(MN-2,5)-ACON*W(MN,5))**2+(W(MN-2,7)-ACON*W(MN,7))**2+(W(MFDIFF241
   1N-2,6)-ACON*W(MN,6))**2+(W(MN-2,5)-ACON*W(MN,5))*(W(MN-2,7)-ACON*WFDIFF242
   2(MN,7))                                                           FDIFF243
    ALPHA = SQRT(YC/SSQ)                                              FDIFF244
    W(MN-2,5) = ALPHA*(W(MN-2,5)-ACON*W(MN,5))                        FDIFF245
    W(MN-2,6) = ALPHA*(W(MN-2,6)-ACON*W(MN,6))                        FDIFF246
    W(MN-2,7) = ALPHA*(W(MN-2,7)-ACON*W(MN,7))                        FDIFF247
200 PDER = .TRUE.                                                     FDIFF248
    RHO = W(MN-2,1)                                                   FDIFF249
    E = W(MN-2,4)                                                     FDIFF250
    P = PRS(RHO,E)                                                    FDIFF251
    C2 = PR*P*PE/RHO**2                                               FDIFF252
    IF (C2,GE.0.0) GO TO 240                                          FDIFF253
    WRITE (6,300) MM2,N,MAT,ESY(JS*N),AKT,(W(MN-2,K),K = 1,KMAX)      FDIFF254
    GO TO 230                                                         FDIFF255
210 IF (NEIBR.LT.240) GO TO 230                                       FDIFF256
    L(MN) = 2                                                         FDIFF257
    DO 220 K = 1,KMAX                                                 FDIFF258
220 W(MN-2,K) = W(MN,K)                                               FDIFF259
    GO TO 260                                                         FDIFF260
230 BSAVE = B                                                         FDIFF261
    CALL ONESTP (M,N)                                                 FDIFF262
    B = BSAVE                                                         FDIFF263
    GO TO 260                                                         FDIFF264
240 C = SQRT(C2)                                                      FDIFF265
    UC = (ABS(W(MN-2,2)-ASY(JS*N)*W(MN-2,3))*EIGF(JS*N)*C)*DAX        FDIFF266
    VC = (ABS(W(MN-2,3))*C)*ESY(JS*N)*DAY                             FDIFF267
    SB = AMAX1(UC,VC)                                                 FDIFF268
    IF (SB,LE,SBM) GO TO 250                                          FDIFF269
    SBM = SB                                                          FDIFF270
    ISB = MM2                                                         FDIFF271
    JSB = N                                                           FDIFF272
250 CONTINUE                                                          FDIFF273
    BS = AK*SB                                                        FDIFF274
    IF (BS.GE.0.9) WRITE (6,290) MM2,N,AKT,BS,MAT,(W(MN-2,K),K=1,KMAX)FDIFF275
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      IF (BS.GE.1.0) GO TO 230                                          FDIFF276
  260 CONTINUE                                                          FDIFF277
      DO 270 N = 1,NJ                                                   FDIFF278
      JJ=IJS+(N-1)*NIP2                                                 FDIFF279
      DO 270 M = 1,NI                                                   FDIFF280
      MN=JJ+M                                                           FDIFF281
      L(MN) = L(MN+2)                                                   FDIFF282
  270 CONTINUE                                                          FDIFF283
      DO 280 M = 2,NIM1                                                 FDIFF284
  280 L(IJS+M) = L(IJS+2*NIP2+M)                                        FDIFF285
      FMAT(22,MAT) = CFL/SBM                                            FDIFF286
      IMAT(8,MAT) = ISB                                                 FDIFF287
      IMAT(9,MAT) = JSB                                                 FDIFF288
      RETURN                                                            FDIFF289
C                                                                       FDIFF290
  290 FORMAT (11H AT POINT (I3,1H,I2,16H) IN DIFFP AT T=F9.5,5X5HSTAB=F9FDIFF291
     1.5,5X4HMAT=I2/3H W=7E15.5)                                        FDIFF292
  300 FORMAT (11H AT POINT (I3,1H,I2,1H)31H IMAGINARY SOUND SPEED IN FDIFDIFF293
     1FF5X4HMAT=I2,3X4HESV=F9.5,3X2HT=F9.5/3H W=7E15.5)                 FDIFF294
      END                                                               FDIFF295
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      SUBROUTINE ONESTP (II,JJ)                                          ONESTP 2
      COMMON// W(2200,7),L(2200)                                         INTVAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                 BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                    BNDCRS 3
      COMMON/MSHFCN/ Y(78),DY(78),DYA(78),ESY(78),YSE(78),ESYA(78),      MSHFCN 2
     1YSEA(78),ESYE(78),EIGF(78),ASY(78),AYY(78),ASYA(78)                MSHFCN 3
      COMMON /MATARR/ NMAT,IMAT(12,9),FMAT(23,5),MAT                     MATARR 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LR,LF                                     COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,RMAX,FACT,ANG,AF,SRH,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,FRTDMU,ODVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                       MATVAL 6
      COMMON /PRESS/ PDER,PR,PE,MATNO                                    PRESS  2
      COMMON /DER1/ RT,UT,VT,ET,S11T,S12T,S22T                           ONESTP10
      COMMON /DER2/ RTT,UTT,VTT,ETT,S11TT,S12TT,S22TT                    ONESTP11
      DIMENSION WW(7), WT(7), WTT(7)                                     ONESTP12
      DIMENSION WSA(7), WSB(7), WSAA(7), WSBB(7), WSAB(7)                ONESTP13
      EQUIVALENCE (RT,WT(1)), (RTT,WTT(1))                               ONESTP14
      REAL K1,K2                                                         ONESTP15
      LOGICAL AXIS                                                       ONESTP16
      REAL MU,MUMHS,MUPHS                                                ONESTP17
      LOGICAL PDER                                                       ONESTP18
      HAX = 0.5*AX                                                       ONESTP19
      HAY = 0.5*AY                                                       ONESTP20
      I = II                                                             ONESTP21
      J = JJ                                                             ONESTP22
      IJ=IJS*(J-1)*NIP2+I                                                ONESTP23
      IM2 = I-2                                                          ONESTP24
      AXIS = .FALSE.                                                     ONESTP25
      IF (J.EQ.2) AXIS = .TRUE.                                          ONESTP26
      AI = FLOAT(I-3)*AX                                                 ONESTP27
      AJ = FLOAT(J-2)*AY                                                 ONESTP28
      DJ = ESY(JS+J)*DY(JS+J)                                            ONESTP29
      DO 10 KK = 1,KMAX                                                  ONESTP30
      WW(KK) = W(IJ,KK)                                                  ONESTP31
   10 CONTINUE                                                           ONESTP32
      PDER = .TRUE.                                                      ONESTP33
      PP = PRS(WW(1),WW(4))                                              ONESTP34
      PPR = PR                                                           ONESTP35
      PPE = PE                                                           ONESTP36
      JPOINT = NEIBR/16                                                  ONESTP37
      IPOINT = NEIBR-16*JPOINT+1                                         ONESTP38
      JPOINT = JPOINT+1                                                  ONESTP39
      GO TO (20,40,20,40,120,80,120,80,20,40,20,40,120,80,120,80), IPOINONESTP40
     1T                                                                  ONESTP41
C     USX IS U SUB X        UXX IS U SUB XX       UXY IS U SUB XY        ONESTP42
C     USY IS U SUB Y       UYY IS U SUB YY                             ONESTP43
C     UT IS U SUB T  UXT IS U SUB XT  UYT IS U SUB YT  UTT IS U SUB TT  ONESTP44
C     SECTION 100 IS FOR WHEN NEITHER (IP,J) NOR (IM,J) IS MISSING       ONESTP45
C                                                                        ONESTP46
   20 DO 30 KK = 1,KMAX                                                  ONESTP47
      WSA(KK) = (W(IJ+1,KK)-W(IJ-1,KK))*HDAX                             ONESTP48
      WSAA(KK) = (W(IJ+1,KK)-2.0*WW(KK)+W(IJ-1,KK))*DAX2                 ONESTP49
   30 CONTINUE                                                           ONESTP50
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      P1 = PRS(W(IJ+1,1),W(IJ+1,4))                                          ONESTP51
      PR1 = PR                                                               ONESTP52
      PE1 = PE                                                               ONESTP53
      P2 = PRS(W(IJ-1,1),W(IJ-1,4))                                          ONESTP54
      PR2 = PR                                                               ONESTP55
      PE2 = PE                                                               ONESTP56
      PSA = (P1-P2)*HDAX                                                     ONESTP57
      PRSA = (PR1-PR2)*HDAX                                                  ONESTP58
      PESA = (PE1-PE2)*HDAX                                                  ONESTP59
      PAA = (P1-2.0*PP+P2)*DAX2                                              ONESTP60
      DELX = AX                                                              ONESTP61
      GO TO 160                                                              ONESTP62
   40 N = JND(JS+J,1)                                                        ONESTP63
      DO 50 K = 2,N                                                          ONESTP64
      IF (AI.LE.PBJ(JS+J,K)) GO TO 60                                        ONESTP65
   50 CONTINUE                                                               ONESTP66
   60 K1 = PBJ(JS+J,K)-AI                                                    ONESTP67
      K2 = AX                                                                ONESTP68
      IF (K1.LT.RDIS*AX) GO TO 680                                           ONESTP69
      DELX = K1                                                              ONESTP70
      DK = 1./(K1*K2*(K1+K2))                                                ONESTP71
      SK1 = DK*K1**2                                                         ONESTP72
      SK2 = DK*K2**2                                                         ONESTP73
      K1 = 2.*K1*DK                                                          ONESTP74
      K2 = 2.*K2*DK                                                          ONESTP75
      DO 70 KK = 1,KMAX                                                      ONESTP76
      WSA(KK) = SK2*(WBJ(JS+J,K,KK)-WW(KK))+SK1*(WW(KK)*W(IJ-1,KK))          ONESTP77
      WSAA(KK) = K2*(WBJ(JS+J,K,KK)-WW(KK))-K1*(WW(KK)*W(IJ-1,KK))           ONESTP78
   70 CONTINUE                                                               ONESTP79
      P1 = PRS(WBJ(JS+J,K,1),WBJ(JS+J,K,4))-PP                               ONESTP80
      PR1 = PR-PPR                                                           ONESTP81
      PE1 = PE-PPE                                                           ONESTP82
      P2 = PP-PRS(W(IJ-1,1),W(IJ-1,4))                                       ONESTP83
      PR2 = PPR-PR                                                           ONESTP84
      PE2 = PPE-PE                                                           ONESTP85
      PSA = SK2*P1+SK1*P2                                                    ONESTP86
      PRSA = SK2*PR1+SK1*PR2                                                 ONESTP87
      PESA = SK2*PE1+SK1*PE2                                                 ONESTP88
      PAA = K2*P1-K1*P2                                                      ONESTP89
      GO TO 160                                                              ONESTP90
   80 N = JND(JS+J,1)                                                        ONESTP91
      DO 90 K = 2,N                                                          ONESTP92
      IF (AI.LE.PBJ(JS+J,K)) GO TO 100                                       ONESTP93
   90 CONTINUE                                                               ONESTP94
  100 K1 = PBJ(JS+J,K)-AI                                                    ONESTP95
      K2 = AI-PBJ(JS+J,K-1)                                                  ONESTP96
      IF (K1.LT.RDIS*AX.OR.K2.LT.RDIS*AX) GO TO 680                          ONESTP97
      DELX = AMIN1(K1,K2)                                                    ONESTP98
      DK = K1+K2                                                             ONESTP99
      SK1 = K1/(K2*DK)                                                       ONEST100
      SK2 = K2/(K1*DK)                                                       ONEST101
      K1 = 2.0/(K1*DK)                                                       ONEST102
      K2 = 2.0/(K2*DK)                                                       ONEST103
      DO 110 KK = 1,KMAX                                                     ONEST104
      WSA(KK) = SK2*(WBJ(JS+J,K,KK)-WW(KK))+SK1*(WW(KK)*WBJ(JS+J,K-1,KK))ONEST105
     1)                                                                      ONEST106
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110 WSAA(KK) = K1*(WBJ(JS+J,K,KK)-WW(KK))+K2*(WW(KK)-WBJ(JS+J,K-1,KK))ONEST107
    P1 = PRS(WBJ(JS+J,K,1),WBJ(JS+J,K,4))-PP                        ONEST108
    PR1 = PR-PPR                                                    ONEST109
    PE1 = PE-PPE                                                    ONEST110
    P2 = PP-PRS(WBJ(JS+J,K-1,1),WBJ(JS+J,K-1,4))                    ONEST111
    PR2 = PPR-PR                                                    ONEST112
    PE2 = PPE-PE                                                    ONEST113
    PSA = SK2*P1+SK1*P2                                             ONEST114
    PRSA = SK2*PR1+SK1*PR2                                          ONEST115
    PESA = SK2*PE1+SK1*PE2                                          ONEST116
    PAA = K2*P1-K1*P2                                               ONEST117
    GO TO 160                                                       ONEST118
120 N = JND(JS+J,1)                                                 ONEST119
    DO 130 K = 2,N                                                  ONEST120
    IF (AI.LT.PBJ(JS+J,K)) GO TO 140                                ONEST121
130 CONTINUE                                                        ONEST122
140 K = K-1                                                         ONEST123
    K2 = AI-PBJ(JS+J,K)                                             ONEST124
    K1 = AX                                                         ONEST125
    IF (K2.LT.RDIS*AX) GO TO 680                                    ONEST126
    DELX = K2                                                       ONEST127
    DK = 1./(K1*K2*(K1+K2))                                         ONEST128
    SK1 = DK*K1**2                                                  ONEST129
    SK2 = DK*K2**2                                                  ONEST130
    K1 = 2.*K1*DK                                                   ONEST131
    K2 = 2.*K2*DK                                                   ONEST132
    DO 150 KK = 1,KMAX                                              ONEST133
    WSA(KK) = SK2*(W(IJ+1,KK)-WW(KK))+SK1*(WW(KK)-WBJ(JS+J,K,KK))   ONEST134
    WSAA(KK) = K2*(W(IJ+1,KK)-WW(KK))-K1*(WW(KK)-WBJ(JS+J,K,KK))    ONEST135
150 CONTINUE                                                        ONEST136
    P1 = PRS(W(IJ+1,1),W(IJ+1,4))-PP                                ONEST137
    PR1 = PR-PPR                                                    ONEST138
    PE1 = PE-PPE                                                    ONEST139
    P2 = PP-PRS(WBJ(JS+J,K,1),WBJ(JS+J,K,4))                        ONEST140
    PR2 = PPR-PR                                                    ONEST141
    PE2 = PPE-PE                                                    ONEST142
    PSA = SK2*P1+SK1*P2                                             ONEST143
    PRSA = SK2*PR1+SK1*PR2                                          ONEST144
    PESA = SK2*PE1+SK1*PE2                                          ONEST145
    PAA = K2*P1-K1*P2                                               ONEST146
160 GO TO (170,170,190,190,170,170,190,190,230,230,270,270,230,230,270ONEST147
   1,270), IPOINT                                                   ONEST148
170 DO 180 KK = 1,KMAX                                              ONEST149
    WSB(KK) = (W(IJ+NIP2,KK)-W(IJ-NIP2,KK))*HDAY                    ONEST150
    WSBB(KK) = (W(IJ+NIP2,KK)-2.0*WW(KK)+W(IJ-NIP2,KK))*DAY2        ONEST151
180 CONTINUE                                                        ONEST152
    P1 = PRS(W(IJ+NIP2,1),W(IJ+NIP2,4))                             ONEST153
    PR1 = PR                                                        ONEST154
    PE1 = PE                                                        ONEST155
    P2 = PRS(W(IJ-NIP2,1),W(IJ-NIP2,4))                             ONEST156
    PR2 = PR                                                        ONEST157
    PE2 = PE                                                        ONEST158
    PSB = (P1-P2)*HDAY                                              ONEST159
    PRSB = (PR1-PR2)*HDAY                                           ONEST160
    PESB = (PE1-PE2)*HDAY                                           ONEST161
    PBB = (P1-2.0*PP+P2)*DAY2                                       ONEST162
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      DELY = AY                                                          ONEST163
      GO TO 330                                                          ONEST164
  190 N = IND(IS+IM2,1)                                                  ONEST165
      DO 200 K = 1,N                                                     ONEST166
      IF (AJ.LE.PBI(IS+IM2,K)) GO TO 210                                 ONEST167
  200 CONTINUE                                                           ONEST168
  210 K1 = PBI(IS+IM2,K)-AJ                                              ONEST169
      K2 = AY                                                            ONEST170
      IF (K1.LT.RDIS*AY) GO TO 680                                       ONEST171
      DK = 1./(K1*K2*(K1+K2))                                            ONEST172
      DELY = K1                                                          ONEST173
      SK1 = DK*K1**2                                                     ONEST174
      SK2 = DK*K2**2                                                     ONEST175
      K1 = 2.*K1*DK                                                      ONEST176
      K2 = 2.*K2*DK                                                      ONEST177
      DO 220 KK = 1,KMAX                                                 ONEST178
      WSB(KK) = SK2*(WBI(IS+IM2,K,KK)-WW(KK))+SK1*(WW(KK)-W(IJ-NIP2,KK))ONEST179
      WSBB(KK) = K2*(WBI(IS+IM2,K,KK)-WW(KK))-K1*(WW(KK)-W(IJ-NIP2,KK)) ONEST180
  220 CONTINUE                                                           ONEST181
      P1 = PRS(WBI(IS+IM2,K,1),WBI(IS+IM2,K,4))-PP                       ONEST182
      PR1 = PR-PPR                                                       ONEST183
      PE1 = PE-PPE                                                       ONEST184
      P2 = PP-PRS(W(IJ-NIP2,1),W(IJ-NIP2,4))                             ONEST185
      PR2 = PPR-PR                                                       ONEST186
      PE2 = PPE-PE                                                       ONEST187
      PSB = SK2*P1+SK1*P2                                                ONEST188
      PRSB = SK2*PR1+SK1*PR2                                             ONEST189
      PESB = SK2*PE1+SK1*PE2                                             ONEST190
      PBB = K2*P1-K1*P2                                                  ONEST191
      GO TO 330                                                          ONEST192
  230 N = IND(IS+IM2,1)                                                  ONEST193
      DO 240 K = 1,N                                                     ONEST194
      IF (AJ.LT.PBI(IS+IM2,K)) GO TO 250                                 ONEST195
  240 CONTINUE                                                           ONEST196
  250 K = K-1                                                            ONEST197
      K2 = AJ-PBI(IS+IM2,K)                                              ONEST198
      K1 = AY                                                            ONEST199
      IF (K2.LT.RDIS*AY) GO TO 680                                       ONEST200
      DK = 1./(K1*K2*(K1+K2))                                            ONEST201
      DELY = K2                                                          ONEST202
      SK1 = DK*K1**2                                                     ONEST203
      SK2 = DK*K2**2                                                     ONEST204
      K1 = 2.*K1*DK                                                      ONEST205
      K2 = 2.*K2*DK                                                      ONEST206
      DO 260 KK = 1,KMAX                                                 ONEST207
      WSB(KK) = SK2*(W(IJ+NIP2,KK)-WW(KK))+SK1*(WW(KK)-WBI(IS+IM2,K,KK))ONEST208
      WSBB(KK) = K2*(W(IJ+NIP2,KK)-WW(KK))-K1*(WW(KK)-WBI(IS+IM2,K,KK)) ONEST209
                                                                         ONEST210
  260 CONTINUE                                                           ONEST211
      P1 = PRS(W(IJ+NIP2,1),W(IJ+NIP2,4))-PP                             ONEST212
      PR1 = PR-PPR                                                       ONEST213
      PE1 = PE-PPE                                                       ONEST214
      P2 = PP-PRS(WBI(IS+IM2,K,1),WBI(IS+IM2,K,4))                       ONEST215
      PR2 = PPR-PR                                                       ONEST216
      PE2 = PPE-PE                                                       ONEST217
      PSB = SK2*P1+SK1*P2                                                ONEST218
      PRSB = SK2*PR1+SK1*PR2
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      PESB = SK2*PE1+SK1*PE2                                                ONEST219
      PBB = K2*P1-K1*P2                                                     ONEST220
      GO TO 330                                                             ONEST221
  270 N = IND(IS+IM2,1)                                                     ONEST222
      DO 280 K = 1,N                                                        ONEST223
      IF (AJ.LE.PBI(IS+IM2,K)) GO TO 290                                    ONEST224
  280 CONTINUE                                                              ONEST225
  290 K1 = PBI(IS+IM2,K)-AJ                                                 ONEST226
      IF (K1.LT.RDIS*AY) GO TO 680                                          ONEST227
      IF (J.EQ.2) GO TO 310                                                 ONEST228
      K2 = AJ-PBI(IS+IM2,K-1)                                               ONEST229
      IF (K2.LT.RDIS*AY) GO TO 680                                          ONEST230
      DELY = AMIN1(K1,K2)                                                   ONEST231
      DK = 1./(K1*K2*(K1+K2))                                               ONEST232
      SK1 = DK*K1**2                                                        ONEST233
      SK2 = DK*K2**2                                                        ONEST234
      K1 = 2.*K1*DK                                                         ONEST235
      K2 = 2.*K2*DK                                                         ONEST236
      DO 300 KK = 1,KMAX                                                    ONEST237
      WSB(KK) = SK2*(WBI(IS+IM2,K,KK)-WW(KK))+SK1*(WW(KK)-WBI(IS+IM2,K-1    ONEST238
     1,KK))                                                                 ONEST239
      WSBB(KK) = K2*(WBI(IS+IM2,K,KK)-WW(KK))-K1*(WW(KK)-WBI(IS+IM2,K-1,    ONEST240
     1KK))                                                                  ONEST241
  300 CONTINUE                                                              ONEST242
      P1 = PRS(WBI(IS+IM2,K,1),WBI(IS+IM2,K,4))-PP                          ONEST243
      PR1 = PR-PPR                                                          ONEST244
      PE1 = PE-PPE                                                          ONEST245
      P2 = PP-PRS(WBI(IS+IM2,K-1,1),WBI(IS+IM2,K-1,4))                      ONEST246
      PR2 = PPR-PR                                                          ONEST247
      PE2 = PPE-PE                                                          ONEST248
      PSB = SK2*P1+SK1*P2                                                   ONEST249
      PRSB = SK2*PR1+SK1*PR2                                                ONEST250
      PESB = SK2*PE1+SK1*PE2                                                ONEST251
      PBB = K2*P1-K1*P2                                                     ONEST252
      GO TO 330                                                             ONEST253
  310 WSB(1) = 0.                                                           ONEST254
      WSB(2) = 0.                                                           ONEST255
      WSB(3) = WBI(IS+IM2,K,3)*DAY/K1                                       ONEST256
      DELY = K1                                                             ONEST257
      SK1 = 2.0/(K1*K1)                                                     ONEST258
      DO 320 KK = 1,KMAX                                                    ONEST259
      WSBB(KK) = (WBI(IS+IM2,K,KK)-WW(KK))*SK1                              ONEST260
  320 CONTINUE                                                              ONEST261
      PSB = 0.0                                                             ONEST262
      PRSB = 0.                                                             ONEST263
      PESB = 0.                                                             ONEST264
      PBB = (PRS(WBI(IS+IM2,K,1),WBI(IS+IM2,K,4))-PP)*SK1                   ONEST265
  330 PDER = .FALSE.                                                        ONEST266
      GO TO (540,360,400,360,340,420,400,480,380,380,440,520,340,500,460    ONEST267
     1,680), JPOINT                                                         ONEST268
  340 DO 350 KK = 1,KMAX                                                    ONEST269
      WSAB(KK) = ((W(IJ+NIP2+1,KK)-W(IJ+NIP2+1,KK))*HDAX-WSA(KK))*DAY       ONEST270
  350 CONTINUE                                                              ONEST271
      P1 = PRS(W(IJ+NIP2+1,1),W(IJ+NIP2+1,4))                               ONEST272
      P2 = PRS(W(IJ+NIP2-1,1),W(IJ+NIP2-1,4))                               ONEST273
      PAB = ((P1-P2)*HDAX-PSA)*DAY                                          ONEST274
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      GO TO 560                                                          ONEST275
                                                                         ONEST276
  360 DO 370 KK = 1,KMAX                                                 ONEST277
      WSAB(KK) = (WSA(KK)-(W(IJ-NIP2+1,KK)-W(IJ-NIP2-1,KK))*HDAX)*DAY    ONEST278
  370 CONTINUE                                                           ONEST279
      P1 = PRS(W(IJ-NIP2+1,1),W(IJ-NIP2+1,4))                            ONEST280
      P2 = PRS(W(IJ-NIP2-1,1),W(IJ-NIP2-1,4))                            ONEST281
      PAB = (PSA-(P1-P2)*HDAX)*DAY                                       ONEST282
      GO TO 560                                                          ONEST283
  380 DO 390 KK = 1,KMAX                                                 ONEST284
      WSAB(KK) = (WSB(KK)-(W(IJ+NIP2-1,KK)-W(IJ-NIP2-1,KK))*HDAY)*DAX    ONEST285
  390 CONTINUE                                                           ONEST286
      P1 = PRS(W(IJ+NIP2-1,1),W(IJ+NIP2-1,4))                            ONEST287
      P2 = PRS(W(IJ-NIP2-1,1),W(IJ-NIP2-1,4))                            ONEST288
      PAB = (PSB-(P1-P2)*HDAY)*DAX                                       ONEST289
      GO TO 560                                                          ONEST290
  400 DO 410 KK = 1,KMAX                                                 ONEST291
      WSAB(KK) = ((W(IJ+NIP2+1,KK)-W(IJ-NIP2+1,KK))*HDAY-WSB(KK))*DAX    ONEST292
  410 CONTINUE                                                           ONEST293
      P1 = PRS(W(IJ+NIP2+1,1),W(IJ+NIP2+1,4))                            ONEST294
      P2 = PRS(W(IJ-NIP2+1,1),W(IJ-NIP2+1,4))                            ONEST295
      PAB = ((P1-P2)*HDAY-PSB)*DAX                                       ONEST296
      GO TO 560                                                          ONEST297
  420 DK = -HDAY*DAX                                                     ONEST298
      DO 430 KK = 1,KMAX                                                 ONEST299
  430 WSAB(KK) = (W(IJ+NIP2+1,KK)+W(IJ+NIP2-1,KK)-2.0*WW(K               ONEST300
     1K)-AX*AX*WSAA(KK)-AY*AY*WSBB(KK))*DK                               ONEST301
      P1 = PRS(W(IJ-NIP2+1,1),W(IJ-NIP2+1,4))                            ONEST302
      P2 = PRS(W(IJ+NIP2-1,1),W(IJ+NIP2-1,4))                            ONEST303
      PAB = (P1+P2-2.0*PP-AX*AX*PAA-AY*AY*PBB)*DK                        ONEST304
      GO TO 560                                                          ONEST305
  440 DK = HDAY*DAX                                                      ONEST306
      DO 450 KK = 1,KMAX                                                 ONEST307
  450 WSAB(KK) = (W(IJ+NIP2+1,KK)+W(IJ-NIP2-1,KK)-2.0*WW(K               ONEST308
     1K)-AX*AX*WSAA(KK)-AY*AY*WSBB(KK))*DK                               ONEST309
      P1 = PRS(W(IJ+NIP2+1,1),W(IJ+NIP2+1,4))                            ONEST310
      P2 = PRS(W(IJ-NIP2-1,1),W(IJ-NIP2-1,4))                            ONEST311
      PAB = (P1+P2-2.0*PP-AX*AX*PAA-AY*AY*PBB)*DK                        ONEST312
      GO TO 560                                                          ONEST313
  460 DK = HDAY*DAX                                                      ONEST314
      DO 470 KK = 1,KMAX                                                 ONEST315
  470 WSAB(KK) = (W(IJ+NIP2+1,KK)-WW(KK)-AX*(WSA(KK)+HAX*WSAA(KK))-      ONEST316
     1AY*(WSB(KK)+HAY*WSBB(KK)))*DK                                      ONEST317
      PAB = (PRS(W(IJ+NIP2+1,1),W(IJ+NIP2+1,4))          -PP-AX*(PSA+HAXONEST318
     1+PAA)-AY*(PSB+HAY*PBB))*DK                                         ONEST319
      GO TO 560                                                          ONEST320
  480 DK = -HDAY*DAX                                                     ONEST321
      DO 490 KK = 1,KMAX                                                 ONEST322
  490 WSAB(KK) = (W(IJ+NIP2          +1,KK)-WW(KK)-AX*(WSA(KK)+HAX*WSAA(KONEST323
     1K))+AY*(WSB(KK)-HAY*WSBB(KK)))*DK                                  ONEST324
      PAB = (PRS(W(IJ-NIP2          +1,1),W(IJ+NIP2          +1,4))-PP-AX*ONEST325
     1(PSA+HAX*PAA)+AY*(PSB-HAY*PBB))*DK                                 ONEST326
      GO TO 560                                                          ONEST327
  500 DK = -HDAY*DAX                                                     ONEST328
      DO 510 KK = 1,KMAX                                                 ONEST329
  510 WSAB(KK) = (W(IJ+NIP2      -1,KK)-WW(KK)+AX*(WSA(KK)-HAX*WSAA(KK))-ONEST330
     1AY*(WSB(KK)+HAY*WSBB(KK)))*DK
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      PAB = (PRS(W(IJ+NIP2      -1,1),W(IJ+NIP2      -1,4))-PP+AX+(PSA-HAXONEST331
     1+PAA)-AY+(PSB+HAY+PAB))+DK                                        ONEST332
      GO TO 560                                                         ONEST333
  520 DK = HDAY+DAX                                                     ONEST334
      DO 530 KK = 1,KMAX                                                ONEST335
  530 WSAB(KK) = (W(IJ+NIP2          -1,KK)-WW(KK)+AX+(WSA(KK)+HAX+WSAA(KONEST336
     1K))+AY+(WSB(KK)-HAY+WSBB(KK)))+DK                                 ONEST337
      PAB = (PRS(W(IJ-NIP2          -1,1),W(IJ-NIP2          -1,4))-PP+AX+ONEST338
     1(PSA-HAX+PAA)+AY+(PSB-HAY+PAB))+DK                                ONEST339
      GO TO 560                                                         ONEST340
  540 DO 550 KK = 1,KMAX                                                ONEST341
      WSAB(KK) = (W(IJ+NIP2+1,KK)-W(IJ+NIP2-1,KK)-W(IJ-NIP2+1,KK)+W(IJ-NONEST342
     1IP2-1,KK))+QDAXY                                                  ONEST343
                                                                        ONEST344
  550 CONTINUE                                                          ONEST345
      PAB = (PRS(W(IJ+NIP2      +1,1),W(IJ+NIP2      +1,4))-PRS(W(IJ+NIP2 ONEST346
     1     -1,1),W(IJ+NIP2      -1,4))-PRS(W(IJ-NIP2          +1,1),W(IJ   ONEST347
     2-NIP2       +1,4))+PRS(W(IJ-NIP2          -1,1),W(IJ-NIP2          -1ONEST348
     3,4)))+QDAXY                                                       ONEST349
  560 RR = WW(1)                                                        ONEST350
      UU = WW(2)                                                        ONEST351
      VV = WW(3)                                                        ONEST352
      EE = WW(4)                                                        ONEST353
      S11 = WW(5)                                                       ONEST354
      S12 = WW(6)                                                       ONEST355
      S22 = WW(7)                                                       ONEST356
      DR = 1./RR                                                        ONEST357
      T11 = S11-PP                                                      ONEST358
      T22 = S22-PP                                                      ONEST359
      RSA = WSA(1)                                                      ONEST360
      USA = WSA(2)                                                      ONEST361
      VSA = WSA(3)                                                      ONEST362
      ESA = WSA(4)                                                      ONEST363
      S11A = WSA(5)                                                     ONEST364
      S12A = WSA(6)                                                     ONEST365
      S22A = WSA(7)                                                     ONEST366
      RSB = WSB(1)                                                      ONEST367
      USB = WSB(2)                                                      ONEST368
      VSB = WSB(3)                                                      ONEST369
      ESB = WSB(4)                                                      ONEST370
      S11B = WSB(5)                                                     ONEST371
      S12B = WSB(6)                                                     ONEST372
      S22B = WSB(7)                                                     ONEST373
      RAA = WSAA(1)                                                     ONEST374
      UAA = WSAA(2)                                                     ONEST375
      VAA = WSAA(3)                                                     ONEST376
      EAA = WSAA(4)                                                     ONEST377
      S11AA = WSAA(5)                                                   ONEST378
      S12AA = WSAA(6)                                                   ONEST379
      S22AA = WSAA(7)                                                   ONEST380
      RAB = WSAB(1)                                                     ONEST381
      UAB = WSAB(2)                                                     ONEST382
      VAB = WSAB(3)                                                     ONEST383
      EAB = WSAB(4)                                                     ONEST384
      S11AB = WSAB(5)                                                   ONEST385
      S12AB = WSAB(6)                                                   ONEST386
      S22AB = WSAB(7)
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RBB = WSBB(1)                                                    ONEST387
UBB = WSBB(2)                                                    ONEST388
VBB = WSBB(3)                                                    ONEST389
EBB = WSBB(4)                                                    ONEST390
S11BB = WSBB(5)                                                  ONEST391
S12BB = WSBB(6)                                                  ONEST392
S22BB = WSBB(7)                                                  ONEST393
T11A = S11A-PSA                                                  ONEST394
T22A = S22A-PSA                                                  ONEST395
T11B = S11B-PSB                                                  ONEST396
T22B = S22B-PSB                                                  ONEST397
T11AA = S11AA-PAA                                                ONEST398
T22AA = S22AA-PAA                                                ONEST399
T11AB = S11AB-PAB                                                ONEST400
T22BB = S22BB-PBB                                                ONEST401
B = ESY(JS+J)                                                    ONEST402
BB = YSE(JS+J)*DJ                                                ONEST403
BSE = ESYE(JS+J)                                                 ONEST404
AP = ASY(JS+J)                                                   ONEST405
AYE = AYY(JS+J)                                                  ONEST406
MUPHS = MU+,5*(S11-S22)                                          ONEST407
MUMHS = MU-,5*(S11-S22)                                          ONEST408
UV = UU-AP*VV                                                    ONEST409
UVA = USA-AP*VSA                                                 ONEST410
IF (AXIS) GO TO 580                                              ONEST411
ERHS = PP*S11*S22                                                ONEST412
HSA = ,5*(S11A-S22A)                                             ONEST413
HSB = ,5*(S11B-S22B)                                             ONEST414
FAP12 = FRTDMU-AP*S12                                            ONEST415
S12TWT = S12-TWTDMU*AP                                           ONEST416
TW112 = TWTDMU-AP*S12                                            ONEST417
S12FRT = S12-AP*FRTDMU                                           ONEST418
UVB = USB-AP*VSB-AYE*VV                                          ONEST419
UVAA = UAA-AP*VAA                                                ONEST420
UVAB = UAB-AP*VAB-AYE*VSA                                        ONEST421
VUA = VSA*AP*USA                                                 ONEST422
STUV = S12*USB+T22*VSB                                           ONEST423
STU = T11-AP*S12                                                 ONEST424
STV = S12-AP*T22                                                 ONEST425
STUA = T11A-AP*S12A                                              ONEST426
STVA = S12A-AP*T22A                                              ONEST427
TS2PS1 = DJ*(2,*S22+S11)                                         ONEST428
SIP = TWTDMU*DJ*VV                                               ONEST429
SIPA = TWTDMU*DJ*VSA                                             ONEST430
SIPB = TWTDMU*DJ*(VSB-BR*VV)                                     ONEST431
RBD = RR*VSB+VV*RSB                                              ONEST432
UBD = VV*USB-DR*S12R                                             ONEST433
VBD = VV*VSB-DR*T22R                                             ONEST434
EAD = STU*USA+STV*VSA                                            ONEST435
EBD = VV*ESB-DR*STUV                                             ONEST436
S11BD = VV*S11B-S12*USB+TWTDMU*VSB                               ONEST437
S22BD = VV*S22B+S12*USB-FRTDMU*VSB                               ONEST438
RT = -RR*UVA-UV*RSA-B*RBD-RR*VV*DJ                               ONEST439
UT = -UV*USA+DR*(STUA+DJ*S12)-B*UBD                              ONEST440
VT = -UV*VSA+DR*(STVA+TS2PS1)-B*VBD                              ONEST441
ET = -UV*ESA+DR*EAD-B*EBD-VV*DR*DJ*ERHS                          ONEST442
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 PT = RT*PR*ET*PE                                                        ONEST443
 S11T = -UV*S11A*FAP12*USA-S12TWT*VSA-B*S11BD-SIP                        ONEST444
 S12T = -UV*S12A*MUPHS*VSA-AP*MUMHS*USA-B*(VV*S12B*MUMHS*USB)            ONEST445
 S22T = -UV*S22A-TWT12*USA*S12FRT*VSA-B*S22BD-SIP                        ONEST446
 UVT = UT*AP*VT                                                          ONEST447
 T11T = S11T-PT                                                          ONEST448
 T22T = S22T-PT                                                          ONEST449
 HST = .5*(S11T-S22T)                                                    ONEST450
 SIPT = TWTDMU*DJ*VT                                                     ONEST451
 RAT = -RR*UVAA-2.*RSA*UVA-UV*RAA-B*(RR*VAB*RSA*VSB*VSA*RSB*VV*RAB)ONEST452
1-DJ*(RR*VSA*VV*RSA)                                                     ONEST453
 UAT = -UVA*USA-UV*UAA*DR*(T11AA-AP*S12AA-RSA*DR*(STUA*S12*DJ)*DJ*SONEST454
112A)-B*(VSA*USB*VV*UAB-DR*(S12AB-DR*RSA*S12B))                          ONEST455
 VAT = -UVA*VSA-UV*VAA*DR*(S12AA-AP*T22AA-DR*PSA*(STVA*TS2PS1)*DJ*(ONEST456
12.*S22A*S11A))-B*(VSA*VSB*VV*VAB-DR*(S22AB-PAB-DP*RSA*T22B))            ONEST457
 EAT = -UVA*ESA-UV*EAA*DR*((T11A-AP*S12A)*USA*STU*UAA*(S12A-AP*T22AONEST458
1)*VSA*STV*VAA-DR*RSA*EAD)-B*(VSA*ESB*VV*EAB-DR*(T22A*VSB*T22*VAB*SONEST459
212A*USB*S12*UAB-DR*RSA*STUV))-DJ*DR*(ERHS*(VSA-DR*RSA*VV)*VV*(PSA*ONEST460
3S11A*S22A))                                                             ONEST461
 PAT = RAT*PR*RT*PRSA*EAT*PE*ET*PESA                                     ONEST462
 S11AT = -UVA*S11A-UV*S11AA*FAP12*UAA-S12TWT*VAA-S12A*VUA-B*(VSA*S1ONEST463
11B*VV*S11AB-S12A*USB-S12*UAB-TWTDMU*VAB)-SIPA                           ONEST464
 S12AT = -UVA*S12A-UV*S12AA*HSA*VSA*MUPHS*VAA-AP*(MUMHS*UAA-HSA*USAONEST465
1)-B*(VSA*S12B*VV*S12AB*HSA*USB-MUMHS*UAB)                               ONEST466
 S22AT = -UVA*S22A-UV*S22AA-TWT12*UAA*S12FRT*VAA*S12A*VUA-B*(VSA*S2ONEST467
12B*VV*S22AB*S12A*USB-S12*UAB-FRTDMU*VAB)-SIPA                           ONEST468
 UVAT = UAT-AP*VAT                                                       ONEST469
 RBT = -RR*UVAB-RSB*UVA-UVB*PSA-UV*RAB-B*(RR*VBB*2.*RSB*VSB*VV*RBB)ONEST470
1-BSE*RBD-DJ*(RR*VSB*VV*RSB-BB*RR*VV)                                    ONEST471
 UBT = -UVB*USA-UV*UAB*DR*(T11AB-AP*S12AB-AYE*S12A*DR*RSB*(STUA*DJ*ONEST472
1S12)*DJ*(S12B-BB*S12))-B*(VSB*USB*VV*UBB-DR*(S12BB-DR*RSB*S12B))-BONEST473
2SE*UBD                                                                  ONEST474
 VBT = -UVB*VSA-UV*VAB*DR*(S12AB-AP*(S22AB-PAB)-AYE*T22A*DR*RSB*STVONEST475
1A*DJ*(2.*S22B*S11B-(2.*S22-S11)*BB)-DR*RSB*TS2PS1)-B*(VSB*VSB*VV*VONEST476
2BB-DR*(T22BB-DR*RSB*T22B))-BSE*VBD                                      ONEST477
 EBT = -UVB*ESA-UV*EAB*DR*((T11B-AP*S12B*AYE*S12)*USA*STU*UAB*(S12BONEST478
1-AP*T22B-AYE*T22)*VSA*STV*VAB-DR*RSB*EAD)-B*(VSB*ESB*VV*EBB-DR*(T2ONEST479
22B*VSB*T22*VBB*S12B*USB*S12*UBB-DR*RSB*STUV))-BSE*EBD-DJ*DR*(VSB*EONEST480
3RHS*VV*(PSB*S11B*S22B)-VV*ERHS*(DR*RSB*RB))                             ONEST481
 PBT = RBT*PR*RT*PRSB*EBT*PE*ET*PESB                                     ONEST482
 S11BT = -UVB*S11A-UV*S11AB*FAP12*UAB-S12TWT*VAB-S12B*VUA-AYE*(S12*ONEST483
1USA-TWTDMU*VSA)-B*(VSB*S11B*VV*S11BB*S12B*USB-S12*UBB*TWTDMU*VBB)-ONEST484
2BSE*S11BD-SIPB                                                          ONEST485
 S12BT = -UVB*S12A-UV*S12AB*HSB*VSA*MUPHS*VAB-AP*(MUMHS*UAB-HSB*USAONEST486
1)-AYE*MUMHS*USA-B*(VSB*S12B*VV*S12BB*HSB*USB*MUMHS*UBB)-BSE*(VV*S1ONEST487
22B-MUMHS*USB)                                                           ONEST488
 S22BT = -UVB*S22A-UV*S22AB-TWT12*UAB*S12FRT*VAB*S12B*VUA*AYE*(S12*ONEST489
1USA-FRTDMU*VSA)-B*(VSB*S22B*VV*S22BB*S12B*USB*S12*UBB*FRTDMU*VBB)-ONEST490
2BSE*S22BD-SIPB                                                          ONEST491
 RTT = -UVA*RT-RR*UVAT-RSA*UVT-UV*RAT-B*(RR*VBT*RT*VSB*VV*RBT*VT*RSONEST492
1B)-DJ*(RR*VT*VV*RT)                                                     ONEST493
 UTT = -UVT*USA-UV*UAT*DR*(S11AT-PAT-AP*S12AT-RT*DR*(STUA*S12*DJ)*DONEST494
1J*S12T)-B*(VT*USB*VV*UBT-DR*(S12BT-DR*RT*S12B))                         ONEST495
 VTT = -VSA*UVT-UV*VAT*DR*(S12AT-AP*(S22AT-PAT)-DR*RT*(STVA*TS2PS1)ONEST496
1*DJ*(2.*S22T*S11T))-B*(VT*VSB*VV*VBT-DR*(S22BT-PBT-DR*RT*T22B))         ONEST497
 ETT = -UVT*ESA-UV*EAT*DR*((T11T-AP*S12T)*USA*STU*UAT*(S12T-AP*T22TONEST498
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   1)*VSA*STV*VAT-DR*RT*EAD)-R*(VT*BSB*VV*EBT-DR*(T22T*VSR*T22*VBT*S12ONEST499
   2T*USB*S12*UBT-DR*RT*STUV))-DJ*DR*(VT*ERHS*VV*(PT*S11T*S22T)-DR*RT*ONEST500
   3VV*ERHS)                                                          ONEST501
    S11TT = -UVT*S11A-UV*S11AT*FAP12*UAT-S12TWT*VAT-S12T*VUA-B*(VT*S11ONEST502
   1B*VV*S11BT-S12T*USB*S12*UBT*TWTDMU*VBT)*SIPT                      ONEST503
    S12TT = -UVT*S12A-UV*S12AT*HST*VSA*MUPHS*VAT-AP*(MUMHS*UAT*HST*USAONEST504
   1)*B*(VT*S12B*VV*S12BT*HST*USB*MUMHS*UBT)                          ONEST505
    S22TT = -UVT*S22A-UV*S22AT-TWT12*UAT*S12FRT*VAT*S12T*VUA-B*(VT*S22ONEST506
   1B*VV*S22BT*S12T*USB*S12*UBT*FRTDMU*VBT)*SIPT                      ONEST507
    DO 570 KK = 1,KMAX                                                ONEST508
    W(IJ-2,KK) = W(IJ,KK)*AK*(WT(KK)*HAK*WTT(KK))                     ONEST509
570 CONTINUE                                                          ONEST510
    GO TO 600                                                         ONEST511
580 RT = -RR*USA-UU*RSA-2.*B*RR*VSB                                   ONEST512
    UT = -UU*USA*DR*(T11A*2.*B*S12B)                                  ONEST513
    VT = 0.                                                           ONEST514
    EAD = DR*(T11*USA+2.*B*T22*VSR)                                   ONEST515
    ET = -UU*ESA*EAD                                                  ONEST516
    PT = RT*PR*ET*PE                                                  ONEST517
    S11T = -UU*S11A*FRTDMU*(USA-B*VSB)                                ONEST518
    S12T = 0.                                                         ONEST519
    S22T = -UU*S22A-TWTDMU*(USA-B*VSB)                                ONEST520
    RAT = -RR*UAA-2.*RSA*USA-UU*RAA-2.*B*(RSA*VSB*RR*VAB)             ONEST521
    UAT = -USA*USA-UU*UAA*DR*(T11AA-DR*RSA*T11A*2.*B*(S12AB*DR*RSA*S12ONEST522
   1B))                                                               ONEST523
    EAT = -USA*ESA-UU*EAA*DR*(T11A*USA*T11*UAA-RSA*EAD*2.*B*T22A*VSR*TONEST524
   122*VAB)                                                           ONEST525
    PAT = RAT*PR*RT*PRSA*EAT*PE*ET*PESA                               ONEST526
    S11AT = -USA*S11A-UU*S11AA*FRTDMU*(UAA-B*VAB)                     ONEST527
    S22AT = -USA*S22A-UU*S22AA-TWTDMU*(UAA-B*VAB)                     ONEST528
    VBT = -UU*VAB*DR*(S12AB-AYE*T22A)-B*(VSB*VSB-DR*(T22BB*2.*S22BB*S1ONEST529
   11BB))                                                             ONEST530
    S12BT = -UU*S12AB*MUPHS*VAB-AYE*MUMHS*USA-B*(VSB*S12B-MUMHS*UBB)  ONEST531
    RTT = -RR*UAT-RT*USA-UT*RSA-UU*RAT-2.*B*(RT*VSB*RR*VBT)           ONEST532
    UTT = -UT*USA-UU*UAT*DR*(S11AT-PAT*2.*B*S12BT-DR*RT*(T11A*2.*B*S12ONEST533
   1B))                                                               ONEST534
    VTT = 0.                                                          ONEST535
    ETT = -UT*ESA-UU*EAT*DR*((S11T-PT)*USA*T11*UAT-RT*EAD*2.*B*(S22T-PONEST536
   1T)*VSB*T22*VBT)                                                   ONEST537
    S11TT = -UT*S11A-UU*S11AT*FRTDMU*(UAT-B*VBT)                      ONEST538
    S12TT = 0.                                                        ONEST539
    S22TT = -UT*S22A-UU*S22AT-TWTDMU*(UAT-B*VBT)                      ONEST540
    DO 590 KK = 1,KMAX                                                ONEST541
    W(IJ-2,KK) = W(IJ,KK)*AK*(WT(KK)*HAK*WTT(KK))                     ONEST542
590 CONTINUE                                                          ONEST543
600 Q = VIS*AK*SQRT((UVA*AX)**2+(B*VSB*AY)**2)                        ONEST544
    DO 610 KK = 1,KMAX                                                ONEST545
    W(IJ-2,KK) = W(IJ-2,KK)+Q*(WSAA(KK)*AX**2+WSBB(KK)*AY**2)         ONEST546
610 CONTINUE                                                          ONEST547
    W(IJ-2,4) = AMAX1(W(IJ-2,4),0.0)                                  ONEST548
    YIELD = W(IJ-2,5)**2+W(IJ-2,7)**2+W(IJ-2,6)**2+W(IJ-2,5)*W(IJ-2,7)ONEST549
    IF (YIELD.LT.YC) GO TO 650                                        ONEST550
    IF (AXIS) GO TO 620                                               ONEST551
    WDOT = (WW(5)-AP*WW(6))*USA*(WW(6)-AP*WW(7))*VSA*R*(WW(6)*USB*WW(7ONEST552
   1)*VSB)-(WW(5)*WW(7))*WW(3)*DJ                                     ONEST553
    GO TO 630                                                         ONEST554
```

```
      WDOT = WW(5)*(USA-B*VSB)                                          ONEST555
      WDOT=AMAX1(WDOT,0.0)                                              ONEST556
      ACON = .5*WDOT*HU*AK/YC                                           ONEST557
      SSQ = (W(IJ-2,5)-ACON*W(IJ,5))**2+(W(IJ-2,7)-ACON*W(IJ,7))**2+(W(IONEST558
     1J-2,6)-ACON*W(IJ,6))**2+(W(IJ-2,5)-ACON*W(IJ,5))*(W(IJ-2,7)-ACON*WONEST559
     2(IJ,7))                                                           ONEST560
      ALPHA = SQRT(YC/SSQ)                                              ONEST561
      DO 640 KK = 5,7                                                   ONEST562
      W(IJ-2,KK) = ALPHA*(W(IJ-2,KK)-ACON*W(IJ,KK))                     ONEST563
  640 CONTINUE                                                          ONEST564
  650 RR = W(IJ-2,1)                                                    ONEST565
      UU = W(IJ-2,2)                                                    ONEST566
      VV = W(IJ-2,3)                                                    ONEST567
      EE = W(IJ-2,4)                                                    ONEST568
      PDER = .TRUE.                                                     ONEST569
      PP = PRS(RR,EE)                                                   ONEST570
      C2 = PR*PP*PE/RR**2                                               ONEST571
      IF (C2.LT.0.) GO TO 670                                           ONEST572
      C = SQRT(C2)                                                      ONEST573
      UC = ABS(UU-ASY(JS*J)*VV)+EIGF(JS*J)*C                            ONEST574
      VC = (ABS(VV)+C)*ESY(JS*J)                                        ONEST575
      SB = AMAX1(UC,VC)                                                 ONEST576
      IF (SB.LE.SBM) GO TO 660                                          ONEST577
      SBM = SB                                                          ONEST578
      ISB = IM2                                                         ONEST579
      JSB = J                                                           ONEST580
  660 CONTINUE                                                          ONEST581
      BS = AK*SB                                                        ONEST582
      IF (BS.LT..9) RETURN                                              ONEST583
      WRITE (6,700) IM2,J,AKT,IPOINT,BS,RR,UU,VV,DELX,DELY,ESY(JS*J),MATONEST584
      GO TO 680                                                         ONEST585
  670 WRITE (6,710) IM2,J,RR,UU,VV,AKT,MAT                              ONEST586
  680 L(IJ) = 2                                                         ONEST587
      DO 690 KK = 1,KMAX                                                ONEST588
      W(IJ-2,KK) = W(IJ,KK)                                             ONEST589
  690 CONTINUE                                                          ONEST590
      RETURN                                                            ONEST591
C                                                                       ONEST592
  700 FORMAT (11H AT POINT (I3,1H,I2,17H) IN ONESTP AT T=F9.5/8H IPOINT=ONEST593
     1I2,3X5HSTAB=F7.4,3X4HRHO=F7.4,3X2HU=F7.4,3X2HV=F7.4,3X5HDELA=F5.3,ONEST594
     23X5HDELB=F5.3,3X8HB SUB R=F7.4,3X4HMAT=I2)                        ONEST595
  710 FORMAT (11H AT POINT (I2,1H,I2,33H) IMAGINARY SOUND SPEED IN ONESTONEST596
     1P3X4HRHO=F9.5,3X2HU=F9.5,3X2HV=F9.5,3X2HT=F9.5,3X4HMAT=I2)        ONEST597
      END                                                               ONEST598
```

```
      SUBROUTINE BONDRY                                                 BONDRY 2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON/SCRTCH/ TWB(300,7),TFRX(300),TFRY(300)                     SCRTCH 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     1S,3)                                                              ZONES  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBM,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMJ,TWTDMU,FRTDMU,OOVMMATVAL 4
     3U,TREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      COMMON /PRESS/ PDER,PR,PE,MATNO                                   PRESS  2
      COMMON /INTFC/ NINFC,INFC(60),NCNIN(20,5)                         INTFC  2
      EQUIVALENCE(YZ,T0)                                                OFAX  24
      LOGICAL ERR                                                       BONDRY14
      ETA(Y) = BMAX*ALOG((B*A*Y)/(B-A*Y))*ABL                           BONDRY15
      ALP(X,Y) = FACT*(X*ANG*Y*TOP*ATAN(AF*Y))                          BONDRY16
      DO 90 MAT = 1,NMAT                                                BONDRY17
      CALL GENVAL                                                       BONDRY19
      N1 = IBS*2                                                        BONDRY20
      N2 = IBS*NF                                                       BONDRY21
      FRX(IBS+1) = ALP(FRX(IBS+1),FRY(IBS+1))*XZ                        BONDRY22
      FRY(IBS+1)=ETA(FRY(IBS+1))*YZ                                     OFAX  25
      DO 10 I = N1,N2                                                   BONDRY24
      FRX(I) = ALP(FRX(I),FRY(I))*XZ                                    BONDRY25
      FRY(I)=ETA(FRY(I))*YZ                                             OFAX  26
   10 FRS(I) = FRS(I-1)+SQRT((FRX(I)-FRX(I-1))**2+(FRY(I)-FRY(I-1))**2) BONDRY27
      DO 60 I = 1,NF                                                    BONDRY28
      II = FRX(IBS+I)*DAX+1.0                                           BONDRY29
      JJ = FRY(IBS+I)*DAY+2.0                                           BONDRY30
      DS = 1.0E10                                                       BONDRY31
      KJ = 0                                                            BONDRY32
      DO 20 J = 1,4                                                     BONDRY33
      K = II+MOD(J,2)                                                   BONDRY34
      M = JJ+J/3                                                        BONDRY35
      IF(K.LT.1.OR.K.GT.NI.OR.M.LT.2.OR.M.GT.NJ) GO TO 20               BONDRC11
      MN = IJS+(M-1)*NIP2+K                                             BONDRY36
      IF (L(MN).EQ.0) GO TO 20                                          BONDRY37
      DD = (FRX(IBS+I)-FLOAT(K-1)*AX)**2+(FRY(IBS+I)-FLOAT(M-1)*AY)**2  BONDRY38
      IF (DD.GE.DS) GO TO 20                                            BONDRY39
      KJ = J                                                            BONDRY40
      DS = DD                                                           BONDRY41
   20 CONTINUE                                                          BONDRY42
      IF(KJ.EQ.0) GO TO 60                                              NSMTHB 1
   40 K = II+MOD(KJ,2)                                                  BONDRY47
      M = JJ+KJ/3                                                       BONDRY48
      MN = IJS+(M-1)*NIP2+K                                             BONDRY49
      DO 50 KK = 1,KMAX                                                 BONDRY50
   50 WB(IBS+I,KK) = W(MN,KK)                                           NSMTHB 2
   60 CONTINUE                                                          BONDRY52
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 90 CONTINUE                                                    BONDRY65
    RETURN                                                      BONDRY66
    END                                                         BONDRY67
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      SUBROUTINE DENSB                                                  DENSB  2
      COMMON /BNDVAL/ WB(600,7),FBX(600),FBY(600),FBS(600)              BNDVAL 2
      COMMON/SCRTCH/ TWB(300,7),TFBX(300),TFBY(300)                     SCHTCH 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SRH,AL,AS,AK,WAL,WAS,WAK,GAL,GAS,GAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,PRTDMU,OOVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /PRESS/ PDER,PR,PE,MATNO                                   PRESS  2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      EQUIVALENCE(YZ,T0)                                                OFAX  32
      LOGICAL PDER                                                      DENSB 11
      LOGICAL ERR                                                       DENSB 12
      DATA MAXIT/10/                                                    DENSBC11
      R(Y)=A-B*(CHAN**(BMAX-Y*YZ)-1.0)/(CHAN**(BMAX-Y*YZ)+1.0)          OFAX  33
      Z(X,Y) = X0+(X-XZ)*ANG*Y*TOP*ATAN(AF*Y)                           DENSB 15
      CALL INFACE                                                       DENSB 16
      NIN2=2*NINFC+1                                                    DENSB 17
      DO 10 MAT = 1,NMAT                                                DENSB 18
      DO 10 I = 1,NIN2                                                  DENSB 19
   10 NONIN(I,MAT) = 0                                                  DENSB 20
      DO 70 K = 1,NINFC                                                 DENSB 21
      MAT1 = INFC(6*K-5)                                                DENSB 22
      MAT2 = INFC(6*K-2)                                                DENSB 23
      MAT = MAT1                                                        DENSB 24
      N1 = INFC(6*K-4)                                                  DENSB 25
      N2 = INFC(6*K-3)                                                  DENSB 26
   20 IJ = -1                                                           DENSB 27
   30 IJ = IJ+2                                                         DENSB 28
      IF (NONIN(IJ,MAT).NE.0) GO TO 30                                  DENSB 29
   40 IF (IJ.EQ.1) GO TO 50                                             DENSB 30
      IF (NONIN(IJ-1,MAT).LT.N1) GO TO 50                               DENSB 31
      NONIN(IJ,MAT) = NONIN(IJ-2,MAT)                                   DENSB 32
      NONIN(IJ+1,MAT) = NONIN(IJ-1,MAT)                                 DENSB 33
      IJ = IJ-2                                                         DENSB 34
      GO TO 40                                                          DENSB 35
   50 NONIN(IJ,MAT) = N1                                                DENSB 36
      NONIN(IJ+1,MAT) = N2                                              DENSB 37
      IF (MAT.EQ.MAT2) GO TO 60                                         DENSB 38
      MAT = MAT2                                                        DENSB 39
      N1 = INFC(6*K)                                                    DENSB 40
      N2 = INFC(6*K-1)                                                  DENSB 41
      GO TO 20                                                          DENSB 42
   60 IBS = IMAT(7,MAT2)                                                DENSB 43
      N1 = IBS*INFC(6*K)                                                DENSB 44
      N2 = IBS*INFC(6*K-1)                                              DENSB 45
      DO 70 J = N1,N2                                                   DENSB 46
   70 WB(J,1) = -WB(J,1)                                                DENSB 47
      DO 220 MAT = 1,NMAT                                               DENSB 48
      CALL GENVAL                                                       DENSB 49
      DO 80 J = 1,NF                                                    DENSB 50
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      I = IBS*J                                                          DENSB 51
      TFRY(J) = R(FRY(I))                                                DENSB 52
   80 TFRX(J) = Z(FRX(I),TFRY(J))                                        DENSB 53
      IJ = 1                                                             DENSB 54
      N1 = 1                                                             DENSB 55
      N2 = NONIN(1,MAT)                                                  DENSB 56
      IF (N2.NE.0) GO TO 100                                             DENSB 57
      N1 = IBS*1                                                         DENSB 58
      N2 = IBS*NF                                                        DENSB 59
      GO TO 110                                                          DENSB 60
   90 IJ = IJ+2                                                          DENSB 61
      N1 = NONIN(IJ-1,MAT)+1                                             DENSB 62
      N2 = NONIN(IJ,MAT)                                                 DENSB 63
      IF (N2.NE.0) GO TO 100                                             DENSB 64
      IF (N1.GT.NF) GO TO 190                                            DENSB 65
      N1 = IBS*N1                                                        DENSB 66
      N2 = IBS*NF                                                        DENSB 67
      GO TO 110                                                          DENSB 68
  100 IF (N1.EQ.N2) GO TO 90                                             DENSB 69
      N1 = IBS*N1                                                        DENSB 70
      N2 = IBS*N2-1                                                      DENSB 71
  110 DO 180 I = N1,N2                                                   DENSB 72
      J = I-IBS                                                          DENSB 73
      IF (J.NE.1.AND.J.NE.NF) GO TO 140                                  DENSB 74
      IF (TFRY(J).GT.1.0E-4) GO TO 120                                   DENSB 75
      COSPSI = 0.0                                                       DENSB 76
      SINPSI = 1.0                                                       DENSB 77
      GO TO 160                                                          DENSB 78
  120 IF (J.EQ.NF) GO TO 130                                             DENSB 79
      JP = 2                                                             DENSB 80
      JM=NF-1                                                            DENSBC21
      GO TO 150                                                          DENSB 82
  130 JP=2                                                               DENSBC22
      JM = NF-1                                                          DENSB 84
      GO TO 150                                                          DENSB 85
  140 JP = J+1                                                           DENSB 86
      JM = J-1                                                           DENSB 87
  150 DZ = TFRX(JP)-TFRX(JM)                                             DENSB 88
      DR = TFRY(JP)-TFRY(JM)                                             DENSB 89
      COSPSI = DZ/SQRT(DZ**2+DR**2)                                      DENSB 90
      SINPSI = DR/SQRT(DZ**2+DR**2)                                      DENSB 91
  160 CONTINUE                                                           DENSBC12
      PP = WB(I,5)*SINPSI**2+2.0*WB(I,6)*SINPSI*COSPSI+WB(I,7)*COSPSI**2DENSB107
      E = WB(I,4)                                                        DENSB108
      PDER = .TRUE.                                                      DENSB109
      DO 170 N = 1,MAXIT                                                 DENSB110
      RHO = -WB(I,1)                                                     DENSB111
      P = PRS(RHO,E)                                                     DENSB112
      CORR = (P-PP)/PR                                                   DENSB113
      WB(I,1) = WB(I,1)-CORR                                             DENSB114
      IF(ABS(CORR).LE.ABS(WB(I,1))*EPS1) GO TO 180                       DENSBC13
  170 CONTINUE                                                           DENSB116
      ERR = .TRUE.                                                       DENSB117
      WRITE (6,230) AKT,MAT,J,E,PP,WB(I,1),P,PR,CORR                     DENSB118
  180 CONTINUE                                                           DENSB119
      IF (NONIN(IJ,MAT).NE.0) GO TO 90                                   DENSB120
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  190 DO 220 M = 1,3                                                    DENSB121
      DMAX = 0.0                                                        DENSB122
      DMIN = 1.0E6                                                      DENSB123
      N1 = IBS+NBEG(MAT,M)+1                                            DENSB124
      N2 = IBS+NEND(MAT,M)                                              DENSB125
      WB(N1-1,1)=ABS(WB(N1-1,1))                                        DENSB126
      DO 210 I = N1,N2                                                  DENSB127
      IF (WB(I,1).GE.0.0) GO TO 200                                     DENSB128
      WB(I,1) = -WB(I,1)                                                DENSB129
      GO TO 210                                                         DENSB130
  200 DIFDIS = FRS(I)-FRS(I-1)                                          DENSB131
      DMAX = AMAX1(DMAX,DIFDIS)                                         DENSB132
      DMIN = AMIN1(DMIN,DIFDIS)                                         DENSB133
  210 CONTINUE                                                          DENSB134
      DISMAX(MAT,M) = DMAX                                              DENSB135
  220 DISMIN(MAT,M) = DMIN                                              DENSB136
      RETURN                                                            DENSB137
C                                                                       DENSB138
  230 FORMAT (6H0AT T=F9.5,38H DENSITY DOES NOT CONVERGE ON MATERIALI2, DENSBC14
     118H BOUNDARY AT POINTI4/19H0E,PP,RHO,P,PR,CORR/6E20.7)            DENSBC15
      END                                                               DENSB141
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      SUBROUTINE INFACE                                                 INFACE 2
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON/SCRTCH/ TWB(300,7),TFRX(300),TFRY(300)                     SCRTCH 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /PRESS/ PDER,PR,PE,MATNO                                   PRESS  2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      LOGICAL PDER,ERR                                                  INFAC1 1
      DATA MAXIT/10/                                                    INFAC1 2
      Z(X,Y) = FMAT(9,MAT)*(X-FMAT(12,MAT))+FMAT(20,MAT)*Y*TOP*ATAN(FMAT INFACE11
     1(21,MAT)*Y)                                                       INFACE12
      CH(Y)=FMAT(17,MAT)**(FMAT(18,MAT)*Y+FMAT(11,MAT))                 OFAX   34
      R(Y) = FMAT(13,MAT)-FMAT(14,MAT)*(CH(Y)-1.0)/(CH(Y)+1.0)          INFACE14
      PDER=.TRUE.                                                       INFAC1 3
      DO 60 K = 1,NINFC                                                 INFACE16
      MAT1 = INFC(6*K-5)                                                INFACE17
      MAT2 = INFC(6*K-2)                                                INFACE18
      RHO1 = FMAT(8,MAT1)                                               INFACE19
      RHO2 = FMAT(8,MAT2)                                               INFACE20
      RH12 = RHO1*RHO2                                                  INFACE21
      IBS = IMAT(7,MAT1)                                                INFACE22
      N1 = IBS*INFC(6*K-4)                                              INFACE23
      N2 = IBS*INFC(6*K-3)                                              INFACE24
      NF = NEND(MAT1,3)                                                 INFACE25
      MAT = MAT1                                                        INFACE26
      J = IMAT(7,MAT2)+INFC(6*K-1)+1                                    INFACE27
      DO 60 I = N1,N2                                                   INFACE28
      J = J-1                                                           INFACE29
      IJ = I-IBS                                                        INFACE30
      IF (IJ.NE.1.AND.IJ.NE.NF) GO TO 30                                INFACE31
      IF (FRY(I).GT.1.0E-4) GO TO 10                                    INFACE32
      COSPSI = 0.0                                                      INFACE33
      SINPSI = 1.0                                                      INFACE34
      GO TO 50                                                          INFACE35
   10 IF (IJ.EQ.NF) GO TO 20                                            INFACE36
      IP = IBS*2                                                        INFACE37
      IM=IBS*NF-1                                                       INFAC2 1
      GO TO 40                                                          INFACE39
   20 IP=IBS*2                                                          INFAC2 2
      IM = IBS*NF-1                                                     INFACE41
      GO TO 40                                                          INFACE42
   30 IP = I+1                                                          INFACE43
      IM = I-1                                                          INFACE44
   40 RP = R(FRY(IP))                                                   INFACE45
      RM = R(FRY(IM))                                                   INFACE46
      DR = RP-RM                                                        INFACE47
      DZ = Z(FRX(IP),RP)-Z(FRX(IM),RM)                                  INFACE48
      COSPSI = DZ/SQRT(DZ**2+DR**2)                                     INFACE49
      SINPSI = DR/SQRT(DZ**2+DR**2)                                     INFACE50
   50 MATNO = IMAT(10,MAT1)                                             INFACE51
      RHO = WB(I,1)                                                     INFACE52
      E = WB(I,4)                                                       INFACE53
      P1 = PRS(RHO,E)                                                   INFACE54
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```
      MAINO = IMAT(10,MAT2)                                              INFACE55
      RHO = WB(J,1)                                                      INFACE56
      E = WB(J,4)                                                        INFACE57
      P2 = PRS(RHO,E)                                                    INFACE58
      SINSQ = SINPSI**2                                                  INFACE59
      COSSQ = COSPSI**2                                                  INFACE60
      SINCOS = SINPSI*COSPSI                                             INFACE61
      TNN1 = (WB(I,5)-P1)*SINSQ+2.0*WB(I,6)*SINCOS+(WB(I,7)-P1)*COSSQ    INFACE62
      TNN2 = (WB(J,5)-P2)*SINSQ+2.0*WB(J,6)*SINCOS+(WB(J,7)-P2)*COSSQ    INFACE63
      UN1 = WB(I,2)*SINPSI+WB(I,3)*COSPSI                                INFACE66
      UN2 = WB(J,2)*SINPSI+WB(J,3)*COSPSI                                INFACE67
      UT1 = WB(I,3)*SINPSI-WB(I,2)*COSPSI                                INFACE68
      UT2 = WB(J,3)*SINPSI-WB(J,2)*COSPSI                                INFACE69
      TNN = RH12*(WB(J,1)*TNN1+WB(I,1)*TNN2)/(RH01*WB(I,1)+RH02*WB(J,1)) INFACE70
      TNN1 = TNN/RH01                                                    INFACE71
      TNN2 = TNN/RH02                                                    INFACE72
      CON1 = RH01*WB(I,1)                                                INFACE75
      CON2 = RH02*WB(J,1)                                                INFACE76
      UN = (CON1*UN1+CON2*UN2)/(CON1+CON2)                               INFACE77
      WB(I,2) = UN*SINPSI-UT1*COSPSI                                     INFACE84
      WB(J,2) = UN*SINPSI-UT2*COSPSI                                     INFACE85
      WB(I,3) = UN*COSPSI+UT1*SINPSI                                     INFACE86
      WB(J,3) = UN*COSPSI+UT2*SINPSI                                     INFACE87
      TNN=TNN1                                                           INFAC1 4
      MAT=MAT1                                                           INFAC1 5
      M=I                                                                INFAC1 6
   52 MAINO=IMAT(10,MAT)                                                 INFAC1 7
      IF(MATNO.GT.100) GO TO 56                                          INFAC1 8
      E=WB(M,4)                                                          INFAC1 9
      PP=WB(M,5)*SINSQ+2.0*WB(M,6)*SINCOS+WB(M,7)*COSSQ-TNN              INFAC110
      DO 54 N=1,MAXIT                                                    INFAC111
      RHO=-WB(M,1)                                                       INFAC112
      P=PRS(RHO,E)                                                       INFAC113
      CORR=(P-PP)/PR                                                     INFAC114
      WB(M,1)=WB(M,1)-CORR                                               INFAC115
      IF(ABS(CORR).LE.ABS(WB(M,1))*EPS1) GO TO 56                        INFAC116
   54 CONTINUE                                                           INFAC117
      ERR=.TRUE.                                                         INFAC118
      MM=M-IMAT(7,MAT)                                                   INFAC3 1
      WRITE(6,100) AKT,MAT,MM,E,PP,WB(M,1),P,PR,CORR                     INFAC3 2
   56 IF(MAT.EQ.MAT2) GO TO 60                                           INFAC121
      TNN=TNN2                                                           INFAC122
      MAT=MAT2                                                           INFAC123
      M=J                                                                INFAC124
      GO TO 52                                                           INFAC125
   60 CONTINUE                                                           INFACE88
      RETURN                                                             INFACE89
  100 FORMAT (6H0AT T=F9.5,38H DENSITY DOES NOT CONVERGE ON MATERIAL2,   INFAC126
     118H BOUNDARY AT POINT14/19H0E,PP,RHO,P,PR,CORR/6E20.7)             INFAC127
      END                                                                INFACE90
```

```
      SUBROUTINE FINISH                                                 FINISH 2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PRI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PRJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(400,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIPR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBP,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,FRTDMU,OOVMMATVAL 4
     3U,IREDTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      LOGICAL ERR                                                       FINISH12
      ZBMAX = AX*FLOAT(NIM1)                                            FINISH13
      RBMAX = AY*FLOAT(NJ-2)                                            FINISH14
      ZMN = 1.0E6                                                       FINISH15
      ZMX = -ZMN                                                        FINISH16
      RMX = ZMX                                                         FINISH17
      RMN=ZMN                                                           OFAX  35
      DO 10 I = 1,NF                                                    FINISH18
      ZMN = AMIN1(ZMN,FRX(IBS+I))                                       FINISH19
      ZMX = AMAX1(ZMX,FRX(IBS+I))                                       FINISH20
      RMN=AMIN1(RMN,FRY(IBS+I))                                         OFAX  36
   10 RMX = AMAX1(RMX,FRY(IBS+I))                                       FINISH21
      IF(RMX.GE.RBMAX.OR.RMN.LT.-1.0E-4) GO TO 60                       OFAX  37
      IF(ZMN.LE.0.0) GO TO 15                                           FINISH23
      IF(ZMX.LT.ZBMAX) GO TO 70                                         FINISH24
      ISH=INT(ZMN*DAX)                                                  FINISH25
      K=0                                                               FINISH26
      INC=1                                                             FINISH27
      GO TO 18                                                          FINISH28
   15 ISH=INT((ZMX-ZBMAX)*DAX)                                          FINISH29
      K=NI+1                                                            FINISH30
      INC=-1                                                            FINISH31
   18 ISH=ISH/2                                                         FINISC21
      JSH=IABS(ISH)                                                     FINISC22
      IF(JSH.LE.2) GO TO 60                                             FINISH33
      ZDF = FLOAT(ISH)*AX                                               FINISH34
      XZ=XZ+ZDF                                                         FINISC23
      FMAT(12,MAT) = XZ                                                 FINISH36
      DO 20 I = 1,NF                                                    FINISH37
   20 FRX(IBS+I)=FRX(IBS+I)-ZDF                                         FINISC24
      ISP=JSH+1                                                         FINISH39
      DO 40 M = ISP,NI                                                  FINISH40
      K=K+INC                                                           FINISH41
      I=K+ISH                                                           FINISH42
      DO 30 J = 1,NJ                                                    FINISH43
      JJ = IJS+(J-1)*NIP2                                               FINISH44
      L(JJ+K) = L(JJ+I)                                                 FINISH45
      DO 30 KK = 1,KMAX                                                 FINISH46
   30 W(JJ+K,KK) = W(JJ+I,KK)                                           FINISH
```

```
      DO 40 J = 1,9                                                     FINISH48
   40 IND(IS*K,J) = IND(IS*I,J)                                         FINISH49
      DO 50 I=1,JSH                                                     FINISH50
      K=K*INC                                                           FINISH51
      DO 50 J = 1,NJ                                                    FINISH52
      JJ = IJS*(J-1)*NIP2                                               FINISH53
   50 L(JJ*K)=0                                                         FINISH54
      WRITE (6,170) MAT,ISH                                             FINISH55
      GO TO 70                                                          FINISH56
   60 ERR = .TRUE.                                                      FINISH57
      WRITE (6,180) MAT                                                 FINISH58
      WRITE (6,200) ZBMAX,RRMAX,(FRX(IBS*I),FRY(IBS*I),I = 1,NF)        FINISH59
   70 DO 150 M = 1,3                                                    FINISH60
      LF = NEND(MAT,M)                                                  FINISH61
      LB = NBEG(MAT,M)                                                  FINISH62
      DELS = FRS(IBS*LF)-FRS(IBS*LB)                                    FINISH63
      IF (2.0*ARCSIZ(MAT,M).GT.DELS) GO TO 130                          FINISH64
      LADD = (LF-LB)/2                                                  FINISH65
      IF (NF*LADD.GT.NFMAX) GO TO 130                                   FINISH66
      LM = NF-LF                                                        FINISH67
      IF (LM.EQ.0) GO TO 110                                            FINISH68
      DO 80 I = 1,NTR                                                   FINISH69
      IF (ITR(MAT,I).LT.LF) GO TO 80                                    FINISH70
      ITR(MAT,I) = ITR(MAT,I)*LADD                                      FINISH71
   80 CONTINUE                                                          FINISH72
      NIN2 = 2*NINFC                                                    FINISH73
      DO 90 I = 1,NIN2                                                  FINISH74
      IF (INFC(3*I-2).NE.MAT) GO TO 90                                  FINISH75
      IF (INFC(3*I-1).GE.LF) INFC(3*I-1) = INFC(3*I-1)*LADD             FINISH76
      IF (INFC(3*I).GE.LF) INFC(3*I) = INFC(3*I)*LADD                   FINISH77
   90 CONTINUE                                                          FINISH78
      NF1 = NF*1                                                        FINISH79
      DO 100 LL = 1,LM                                                  FINISH80
      L1 = NF1-LL                                                       FINISH81
      L2 = L1*LADD                                                      FINISH82
      FRX(IBS*L2) = FRX(IBS*L1)                                         FINISH83
      FRY(IBS*L2) = FRY(IBS*L1)                                         FINISH84
      DO 100 KK = 1,KMAX                                                FINISH85
      WB(IBS*L2,KK) = WB(IBS*L1,KK)                                     FINISH86
  100 CONTINUE                                                          FINISH87
  110 DO 120 L1 = M,3                                                   FINISH88
      IF (L1.EQ.1) GO TO 120                                            FINISH89
      NBEG(MAT,L1) = NEND(MAT,L1-1)                                     FINISH90
  120 NEND(MAT,L1) = NEND(MAT,L1)*LADD                                  FINISH91
      NF = NF*LADD                                                      FINISH92
      NE = NEND(MAT,2)                                                  FINISH93
      NE1 = NE*1                                                        FINISH94
      ND = NEND(MAT,1)                                                  FINISH95
      ND1 = ND*1                                                        FINISH96
      WRITE (6,190) MAT,M,DELS,ARCSIZ(MAT,M),AKT                        FINISH97
      ARCSIZ(MAT,M) = DELS                                              FINISH98
      GO TO 140                                                         FINISH99
  130 DELS = DELS/FLOAT(LF-LB)                                          FINIS100
      IF (DISMIN(MAT,M).GE.(1.0-DAL)*DELS.AND.DISMAX(MAT,M).LE.(1.0+DAL)FINIS101
     1*DELS) GO TO 150                                                  FINIS102
      WRITE (6,160) MAT,M,DELS,DISMIN(MAT,M),DISMAX(MAT,M),AKT          FINIS103
```

```
  140 CALL RELABL (M)                                                    FINIS104
  150 CONTINUE                                                           FINIS105
      RETURN                                                             FINIS106
                                                                         FINIS107
C
  160 FORMAT (18H REZONING MATERIALI2,8H SURFACEI2,6X5HDELS=F10.7,6X7HDIFINIS108
     1SMIN=F10.7,6X7HDISMAX=F10.7,6X2HT=F9.5)                            FINIS109
  170 FORMAT (9H0MATERIALI2,30H BOUNDARY EXCEEDS DOMAIN SHIFT15)         FINIS110
  180 FORMAT (9H0MATERIALI2,36H BOUNDARY EXCEEDS DOMAIN=RUN ABORTED)     FINIS111
  190 FORMAT (26H ADDING POINTS TO MATERIALI2,5H SIDEI2,6X8HARCSIZE=F12.FINIS112
     15,6X12HOLD ARCSIZE=F12.5,6X2HT=F9.5)                               FINIS113
  200 FORMAT (24H0(ZMAX,RMAX)/(Z(I),R(I))/F11.3,F9.3/(6(F11.3,F9.3)))    FINIS114
      END                                                                FINIS115
```

```
      SUBROUTINE RELABL (M)                                                 RELABL 2
      COMMON /BNDVAL/ NB(600,7),FRX(600),FRY(600),FPS(600)                  BNDVAL 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                                  ZONES  3
      COMMON /MATARR/ XMAT,INAT(12,5),FMAT(23,5),MAT                        MATARR 2
      COMMON/SCRTCH/ TNB(300,7),TFRX(300),TFRY(300)                         SCRTCH 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                        COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,X0,P0,T0,XZ,A,R,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBU,AL,AS,AK,HAL,HAS,HAK,GAL,GAS,GAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTP,HALFMU,TWTDMU,FPTDMU,ODVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSP,NIM1,NJM1,ND,ND1,NF,NE1MATVAL 5
     4,NF,NIP2,NTR                                                          MATVAL 6
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                           TRCPRT 2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                             INTFC  2
      DATA EPS/1.E-5/                                                       RELABL11
   10 MF = NEND(MAT,M)                                                      RELABL12
      NB = NBEG(MAT,M)                                                      RELABL13
C     LB IS THE BEGINNING OF THE OLD SET                                    RELABL14
C     NB IS THE BEGINNING OF THE NEW SET                                    RELABL15
C     LF IS THE END OF THE OLD SET                                          RELABL16
C     MF IS THE END OF THE NEW SET                                          RELABL17
C                                                                           RELABL18
      NB1 = NB+1                                                            RELABL19
      NFM1 = MF-1                                                           RELABL20
      DELS = (FRS(IBS+LF)-FRS(IBS+LB))/FLOAT(MF-NB)                         RELABL21
      S = FRS(IBS+LB)                                                       RELABL22
      K = LB+1                                                              RELABL23
      DO 20 J = 1,NTR                                                       RELABL24
      IF (ITR(MAT,J).GE.LB) GO TO 40                                        RELABL25
   20 CONTINUE                                                              RELABL26
   30 STR = 1.0E10                                                          RELABL27
      IJ = LF+1                                                             RELABL28
      GO TO 50                                                              RELABL29
   40 IJ = ITR(MAT,J)                                                       RELABL30
      IF (IJ.GE.LF) GO TO 30                                                RELABL31
      STR = FRS(IBS+IJ)+TRS(MAT,J)*(FRS(IBS+IJ+1)-FRS(IBS+IJ))              RELABL32
   50 CONTINUE                                                              RELABL33
      DO 110 I = NB1,NFM1                                                   RELABL34
      S = S+DELS                                                            RELABL35
   60 IF (FRS(IBS+K).GE.S) GO TO 70                                         RELABL36
      K = K+1                                                               RELABL37
      GO TO 60                                                              RELABL38
   70 A0 = (S-FRS(IBS+K))/(FRS(IBS+K-1)-FRS(IBS+K))                         RELABL39
      A1 = 1.0-A0                                                           RELABL40
      TFRX(I) = A0*FRX(IBS+K-1)+A1*FRX(IBS+K)                               RELABL41
      TFRY(I) = A0*FRY(IBS+K-1)+A1*FRY(IBS+K)                               RELABL42
      DO 80 KK = 1,KMAX                                                     RELABL43
   80 TNB(I,KK) = A0*NB(IBS+K-1,KK)+A1*NB(IBS+K,KK)                         RELABL44
   90 IF (STR.GT.S) GO TO 110                                               RELABL45
      ITR(MAT,J) = I-1                                                      RELABL46
      TRS(MAT,J) = (STR-S+DELS)/DELS                                        RELABL47
      J = J+1                                                               RELABL48
      IF (J.GT.NTR) GO TO 100                                               RELABL49
      IJ = ITR(MAT,J)                                                       RELABL50
      IF (IJ.GE.LF) GO TO 100                                               RELABL51
```

```
      STR = FRS(IBS+IJ)+TRS(MAT,J)*(FRS(IBS+IJ+1)-FRS(IBS+IJ))          RELABL52
      GO TO 90                                                          RELABL53
  100 STR = 1.0E10                                                      RELABL54
      IJ = LF+1                                                         RELABL55
  110 CONTINUE                                                          RELABL56
      IF (IJ.GE.LF) GO TO 130                                           RELABL57
      DO 120 I = J,NTR                                                  RELABL58
      IJ = ITR(MAT,I)                                                   RELABL59
      IF (IJ.GE.LF) GO TO 130                                           RELABL60
      STR = FRS(IBS+IJ)+TRS(MAT,I)*(FRS(IBS+IJ+1)-FRS(IBS+IJ))          RELABL61
      ITR(MAT,I) = NFM1                                                 RELABL62
  120 TRS(MAT,I) = (STR-S)/DELS                                         RELABL63
  130 CONTINUE                                                          RELABL64
      TFRX(NB) = FRX(IBS+LB)                                            RELABL65
      TFRY(NB) = FRY(IBS+LB)                                            RELABL66
      TFRX(NF) = FRX(IBS+LF)                                            RELABL67
      TFRY(NF) = FRY(IBS+LF)                                            RELABL68
      DO 140 KK = 1,KMAX                                                RELABL69
      TWB(NB,KK) = WB(IBS+LB,KK)                                        RELABL70
  140 TWB(NF,KK) = WB(IBS+LF,KK)                                        RELABL71
C                                                                       RELABL72
C     WE HAVE JUST FOUND FU AND FV                                      RELABL73
C                                                                       RELABL74
      DO 150 I = NB,NF                                                  RELABL75
      FRX(IBS+I) = TFRX(I)                                              RELABL76
      FRY(IBS+I) = TFRY(I)                                              RELABL77
      DO 150 KK = 1,KMAX                                                RELABL78
  150 WB(IBS+I,KK) = TWB(I,KK)                                          RELABL79
      TFRX(1) = 0.0                                                     RELABL80
      DO 160 I = 2,NF                                                   RELABL81
      TFRX(I) = FRS(IBS+I)                                              RELABL82
  160 FRS(IBS+I) = FRS(IBS+I-1)+SQRT((FRY(IBS+I)-FRY(IBS+I-1))**2+(FRY(IRELABL83
     1BS+I)-FRX(IBS+I-1))**2)                                           RELABL84
      NIN2 = 2*NINFC                                                    RELABL85
      N1 = IBS+NB1                                                      RELABL86
      N2 = IBS+NF                                                       RELABL87
      DO 220 I = 1,NIN2                                                 RELABL88
      IF (INFC(3*I-2),NF,MAT) GO TO 220                                 RELABL89
      IJ = MOD(I,2)                                                     RELABL90
      K1 = 3*I-IJ                                                       RELABL91
      I1 = INFC(K1)                                                     RELABL92
      K2 = 3*I-1+IJ                                                     RELABL93
      I2 = INFC(K2)                                                     RELABL94
      IF (I1.LE.LB.OR.I1.GT.LF) GO TO 190                               RELABL95
      S = TFRX(I1)                                                      RELABL96
      DO 170 J = N1,N2                                                  RELABL97
      IF (S.LE.FRS(J)) GO TO 180                                        RELABL98
  170 CONTINUE                                                          RELABL99
      J = N2                                                            RELAB100
  180 INFC(K1) = J-IBS                                                  RELAB101
  190 IF (I2.LE.LB.OR.I2.GT.LF) GO TO 220                               RELAB102
      S = TFRX(I2)                                                      RELAB103
      DO 200 J = N1,N2                                                  RELAB104
      IF (S.LT.FRS(J)) GO TO 210                                        RELAB105
  200 CONTINUE                                                          RELAB106
      J = N2+1                                                          RELAB107
```

```
210 INFO(K2) = J-1-IBS                                          RELAB106
220 CONTINUE                                                    RELAB109
    RETURN                                                      RELAB110
    END                                                         RELAB111
```

```
      SUBROUTINE BPOSN                                                  BPOSN  2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(400,7),FBX(600),FBY(600),FBS(600)              BNDVAL 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIGR,IPOINT,ERR,EPS,EPS1,FDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,PHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SRU,AL,AS,AK,HAL,HAS,HAK,CAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTOMU,FRTOMU,OOVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      LOGICAL ERR                                                       BPOSN  7
      DATA IM,JM,MXSI,MXSJ/2HI=,2HJ=,8,8/                              BPOSN  8
      DO 10 I = 1,NI                                                    BPOSN  9
   10 IND(IS+I,1) = 0                                                   BPOSN 10
      DO 20 J=1,NJ                                                      BPOSN 11
   20 JND(JS+J,1) = 0                                                   BPOSN 12
      IA = FBX(IBS+1)+DAX                                               BPOSN 13
      JA = FBY(IBS+1)+DAY                                               BPOSN 14
      IF(ABS(FBY(IBS+1)),LE,1.0E-4) JA=-1                               BPOSN 15
      DO 170 L = 2,NF                                                   BPOSN 16
      IB = FBX(IBS+L)+DAX                                               BPOSN 17
      JB = FBY(IBS+L)+DAY                                               BPOSN 18
      IF(ABS(FBY(IBS+L)),GT,1.0E-4) GO TO 30                            BPOSN 19
      IA=IB                                                             BPOSN 20
      JB=-1                                                             BPOSN 21
   30 IC = IB-IA                                                        BPOSN 22
      IF (IC) 40,100,50                                                 BPOSN 23
   40 IP = IA+1                                                         BPOSN 24
      IA = IA-1                                                         BPOSN 25
      GO TO 60                                                          BPOSN 26
   50 IA = IA+1                                                         BPOSN 27
      IP = IA+1                                                         BPOSN 28
   60 K = IND(IS+IP,1)+1                                                BPOSN 29
      IF (K,GT,MXSI) GO TO 90                                           BPOSN 30
      IND(IS+IP,1) = K                                                  BPOSN 31
   70 IF (K,EQ,1) GO TO 80                                              BPOSN 32
      LA = IND(IS+IP,K)                                                 BPOSN 33
      IF (FBY(IBS+LA),LE,FBY(IBS+L-1)) GO TO 80                         BPOSN 34
      IND(IS+IP,K+1) = IND(IS+IP,K)                                     BPOSN 35
      K = K-1                                                           BPOSN 36
      GO TO 70                                                          BPOSN 37
   80 IND(IS+IP,K+1) = L-1                                              BPOSN 38
      GO TO 30                                                          BPOSN 39
   90 WRITE (6,180) IM,IP,MAT,MXSI,AKT                                  BPOSN 40
      ERR = ,TRUE,                                                      BPOSN 41
  100 JC = JB-JA                                                        BPOSN 42
      IF (JC) 110,170,120                                               BPOSN 43
  110 JP = JA+2                                                         BPOSN 44
      JA = JA-1                                                         BPOSN 45
      GO TO 130                                                         BPOSN 46
  120 JA = JA+1                                                         BPOSN 47
      JP = JA+2                                                         BPOSN 48
  130 K = JND(JS+JP,1)+1                                                BPOSN 49
      IF (K,GT,MXSJ) GO TO 160                                          BPOSN 50
```

```
      JND(JS+JP,1) = K                                                    BPOSN 52
                                                                          BPOSN 53
  140 IF (K.EQ.1) GO TO 150                                               BPOSN 54
      LA = JND(JS+JP,K)                                                   BPOSN 55
      IF (FRX(IBS+LA).LE.FRX(IBS+L-1)) GO TO 150                          BPOSN 56
      JND(JS+JP,K+1) = JND(JS+JP,K)                                       BPOSN 57
      K = K-1                                                             BPOSN 58
      GO TO 140                                                           BPOSN 59
  150 JND(JS+JP,K+1) = L-1                                                BPOSN 60
      GO TO 100                                                           BPOSN 61
  160 WRITE (6,180) JH,JP,MAT,MXSJ,AKT                                    BPOSN 62
      ERR = .TRUE.                                                        BPOSN 63
  170 CONTINUE                                                            BPOSN 64
      RETURN                                                              BPOSN 65
C
  180 FORMAT (4H0AT A2,I2,9H MATERIAL,I2,27H BOUNDARY CROSSED MORE THANI  BPOSN 66
     12,6H TIMES3X2HT=F9.5)                                               BPOSN 67
      END                                                                 BPOSN 68
```

```
      SUBROUTINE BVALU                                                  BVALU  2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,PDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBM,AL,AS,AK,HAL,HAS,HAK,CAL,CAS,CAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,FRTDMU,ODVMMATVAL 4
     3U,IREQTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      DO 20 I = 1,NI                                                    BVALU  7
      N = IND(IS+I,1)                                                   BVALU  8
      IF (N.EQ.0) GO TO 20                                              BVALU  9
      X = FLOAT(I-1)*AX                                                 BVALU 10
      DO 10 K = 1,N                                                     BVALU 11
      L = IND(IS+I,K+1)                                                 BVALU 12
      PBI(IS+I,K) = FRY(IBS+L)+(X-FRX(IBS+L))*(FRY(IBS+L+1)-FRY(IBS+L))/BVALU 13
     1(FRX(IBS+L+1)-FRX(IBS+L))                                         BVALU 14
      S = SQRT((X-FRX(IBS+L))**2+(PBI(IS+I,K)-FRY(IBS+L))**2)*FRS(IBS+L)BVALU 15
      A0 = (S-FRS(IBS+L+1))/(FRS(IBS+L)-FRS(IBS+L+1))                   BVALU 16
      A1 = 1.0-A0                                                       BVALU 17
      DO 10 KK = 1,KMAX                                                 BVALU 18
      WBI(IS+I,K,KK) = A0*WB(IBS+L,KK)+A1*WB(IBS+L+1,KK)                BVALU 19
   10 CONTINUE                                                          BVALU 20
   20 CONTINUE                                                          BVALU 21
      DO 50 J=2,NJ                                                      BVALU 22
      N = JND(JS+J,1)                                                   BVALU 23
      IF (N.EQ.0) GO TO 50                                              BVALU 24
      Y = FLOAT(J-2)*AY                                                 BVALU 25
      DO 40 K = 1,N                                                     BVALU 26
      L = JND(JS+J,K+1)                                                 BVALU 27
      PBJ(JS+J,K) = FRX(IBS+L)+(Y-FRY(IBS+L))*(FRX(IBS+L+1)-FRX(IBS+L))/BVALU 28
     1(FRY(IBS+L+1)-FRY(IBS+L))                                         BVALU 29
      S = SQRT((PBJ(JS+J,K)-FRX(IBS+L))**2+(Y-FRY(IBS+L))**2)*FRS(IBS+L)BVALU 30
      A0 = (S-FRS(IBS+L+1))/(FRS(IBS+L)-FRS(IBS+L+1))                   BVALU 31
      A1 = 1.0-A0                                                       BVALU 32
      DO 40 KK = 1,KMAX                                                 BVALU 33
      WBJ(JS+J,K,KK) = A0*WB(IBS+L,KK)+A1*WB(IBS+L+1,KK)                BVALU 34
   40 CONTINUE                                                          BVALU 35
   50 CONTINUE                                                          BVALU 36
      RETURN                                                            BVALU 37
      END                                                               BVALU 38
```

```
      SUBROUTINE INTRPL                                                 INTRPL 2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIPR,IPOINT,EPR,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORQ,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RH0,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SRH,AL,AS,AK,HAL,HAS,HAK,CAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,PRTDMU,OOVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      LOGICAL AXIS                                                      INTRPL 7
      CALL IPOSN                                                        INTRPL 8
      DO 10 I = 2,NIM1                                                  INTRPL 9
      W(IJS+I,1) = W(IJS+2*NIP2+I,1)                                    INTRPL10
      W(IJS+I,2) = W(IJS+2*NIP2+I,2)                                    INTRPL11
      W(IJS+I,3) = -W(IJS+2*NIP2+I,3)                                   INTRPL12
      W(IJS+I,4) = W(IJS+2*NIP2+I,4)                                    INTRPL13
      W(IJS+I,5) = W(IJS+2*NIP2+I,5)                                    INTRPL14
      W(IJS+I,6) = -W(IJS+2*NIP2+I,6)                                   INTRPL15
      W(IJS+I,7) = W(IJS+2*NIP2+I,7)                                    INTRPL16
   10 L(IJS+I) = L(IJS+2*NIP2+I)                                        INTRPL17
      DO 580 J = 2,NJM1                                                 INTRPL18
      JJ = IJS+(J-1)*NIP2                                               INTRPL19
      AXIS = .FALSE.                                                    INTRPL20
      IF (J.EQ.2) AXIS = .TRUE.                                         INTRPL21
      DO 580 I = 2,NIM1                                                 INTRPL22
      IJ = JJ+I                                                         INTRPL23
      IF (L(IJ).NE.2) GO TO 580                                         INTRPL24
      BNDRY = 0                                                         INTRPL25
      AI = FLOAT(I-1)*AX                                                INTRPL26
      AJ = FLOAT(J-2)*AY                                                INTRPL27
      IPOINT = L(IJ-NIP2)+3*L(IJ+NIP2)+9*L(IJ-1)+27*L(IJ+1)             INTRPL28
      JPOINT = IPOINT/9                                                 INTRPL29
      IPOINT = IPOINT-9*JPOINT+1                                        INTRPL30
      IF (AXIS) IPOINT = 9                                              INTRPL31
      JPOINT = JPOINT+1                                                 INTRPL32
      GO TO (20,230,30,100,40,50,60,70,80), IPOINT                      INTRPL33
   20 GO TO (220,480,220,350,420,400,220,530,220), JPOINT               INTRPL34
   30 GO TO (470,480,210,350,420,400,210,530,210), JPOINT               INTRPL35
   40 GO TO (300,480,300,350,170,300,300,300,300), JPOINT               INTRPL36
   50 GO TO (150,480,150,350,420,150,150,530,150), JPOINT               INTRPL37
   60 GO TO (470,480,90,350,420,400,90,530,90), JPOINT                  INTRPL38
   70 GO TO (280,480,280,350,420,400,280,280,280), JPOINT               INTRPL39
   80 GO TO (470,480,460,350,420,400,340,530,530), JPOINT               INTRPL40
   90 BNDRY = -1                                                        INTRPL41
  100 N = IND(IS+I,1)                                                   INTRPL42
      DO 110 K = 2,N                                                    INTRPL43
      IF (AJ.LT.PBI(IS+I,K)) GO TO 120                                  INTRPL44
  110 CONTINUE                                                          INTRPL45
      K = N+1                                                           INTRPL46
  120 K = K-1                                                           INTRPL47
      IF (BNDRY) 190,130,190                                            INTRPL48
  130 D = PBI(IS+I,K)-AJ                                                INTRPL49
      A0 = AY/(AY-D)                                                    INTRPL50
      A1 = 1.0-A0                                                       INTRPL51
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```
      DO 140 KK = 1,KMAX                                                INTRPL52
  140 W(IJ,KK)=A0*WBI(IS+I,K,KK)+A1*W(IJ+NIP2,KK)                       INTRPL53
      GO TO 570                                                         INTRPL54
  150 DO 160 KK = 1,KMAX                                                INTRPL55
  160 W(IJ,KK) = W(IJ+NIP2,KK)                                          INTRPL56
      GO TO 570                                                         INTRPL57
  170 DO 180 KK = 1,KMAX                                                INTRPL58
  180 W(IJ,KK) = .25*(W(IJ+1,KK)+W(IJ-1,KK)+W(IJ+NIP2,KK)+W(IJ-NIP2,KK))INTRPL59
      GO TO 570                                                         INTRPL60
  190 DO 200 KK = 1,KMAX                                                INTRPL61
  200 W(IJ,KK) = WBI(IS+I,K,KK)                                         INTRPL62
      GO TO 570                                                         INTRPL63
  210 BNDRY = -1                                                        INTRPL64
      GO TO 230                                                         INTRPL65
  220 BNDRY = 1                                                         INTRPL66
  230 N = IND(IS+I,1)                                                   INTRPL67
      DO 240 K = 1,N                                                    INTRPL68
      IF (AJ.LE.PBI(IS+I,K)) GO TO 250                                  INTRPL69
  240 CONTINUE                                                          INTRPL70
      K = N                                                             INTRPL71
  250 D = AJ-PBI(IS+I,K)                                                INTRPL72
      IF (BNDRY) 190,260,320                                            INTRPL73
  260 A0 = AY/(AY+D)                                                    INTRPL74
      A1 = 1.0-A0                                                       INTRPL75
      DO 270 KK = 1,KMAX                                                INTRPL76
  270 W(IJ,KK) = A0*WBI(IS+I,K,KK)+A1*W(IJ-NIP2,KK)                     INTRPL77
      GO TO 570                                                         INTRPL78
  280 DO 290 KK = 1,KMAX                                                INTRPL79
  290 W(IJ,KK) = W(IJ-NIP2,KK)                                          INTRPL80
      GO TO 570                                                         INTRPL81
  300 DO 310 KK = 1,KMAX                                                INTRPL82
  310 W(IJ,KK) = 0.5*(W(IJ+NIP2,KK)+W(IJ+NIP2,KK))                      INTRPL83
      GO TO 570                                                         INTRPL84
  320 D2 = AJ-PBI(IS+I,K-1)                                             INTRPL85
      A0 = D2/(D2+D)                                                    INTRPL86
      A1 = 1.0-A0                                                       INTRPL87
      DO 330 KK = 1,KMAX                                                INTRPL88
  330 W(IJ,KK)                  = A0*WBI(IS+I,K,KK)+A1*WBI(IS+I,K-1,KK) INTRPL89
      GO TO 570                                                         INTRPL90
  340 BNDRY = -1                                                        INTRPL91
  350 N = JND(JS+J,1)                                                   INTRPL92
      DO 360 K = 2,N                                                    INTRPL93
      IF (AI.LT.PBJ(JS+J,K)) GO TO 370                                  INTRPL94
  360 CONTINUE                                                          INTRPL95
      K = N+1                                                           INTRPL96
  370 K = K-1                                                           INTRPL97
      IF (BNDRY) 440,380,440                                            INTRPL98
  380 D = PBJ(JS+J,K)-AI                                                INTRPL99
      A0 = AX/(AX+D)                                                    INTRP100
      A1 = 1.0-A0                                                       INTRP101
      DO 390 KK = 1,KMAX                                                INTRP102
  390 W(IJ,KK)                  = A0*WBJ(JS+J,K,KK)+A1*W(IJ+1,KK)       INTRP103
      GO TO 570                                                         INTRP104
  400 DO 410 KK = 1,KMAX                                                INTRP105
  410 W(IJ,KK) = W(IJ+1,KK)                                             INTRP106
      GO TO 570                                                         INTRP107
```

```
420 DO 430 KK = 1,KMAX                                                  INTRP108
430 W(IJ,KK) = 0.5*(W(IJ+1,KK)+W(IJ-1,KK))                              INTRP109
    GO TO 570                                                           INTRP110
440 DO 450 KK = 1,KMAX                                                  INTRP111
450 W(IJ,KK) = WBJ(JS+J,K,KK)                                           INTRP112
    GO TO 570                                                           INTRP113
460 BNDRY = -1                                                          INTRP114
    GO TO 480                                                           INTRP115
470 BNDRY = 1                                                           INTRP116
480 N = JND(JS+J,1)                                                     INTRP117
    DO 490 K = 1,N                                                      INTRP118
    IF (AI.LE.PBJ(JS+J,K)) GO TO 500                                    INTRP119
490 CONTINUE                                                            INTRP120
    K = N                                                               INTRP121
500 D = AI-PBJ(JS+J,K)                                                  INTRP122
    IF (BNDRY) 440,510,550                                              INTRP123
510 A0 = AX/(AX-D)                                                      INTRP124
    A1 = 1.0-A0                                                         INTRP125
    DO 520 KK = 1,KMAX                                                  INTRP126
520 W(IJ,KK)                  = A0*WBJ(JS+J,K,KK)+A1*W(IJ-1,KK)         INTRP127
    GO TO 570                                                           INTRP128
530 DO 540 KK = 1,KMAX                                                  INTRP129
540 W(IJ,KK) = W(IJ-1,KK)                                               INTRP130
    GO TO 570                                                           INTRP131
550 D2 = AI-PBJ(JS+J,K-1)                                               INTRP132
    A0 = D2/(D2-D)                                                      INTRP133
    A1 = 1.0-A0                                                         INTRP134
    DO 560 KK = 1,KMAX                                                  INTRP135
560 W(IJ,KK)                  = A0*WBJ(JS+J,K,KK)+A1*WBJ(JS+J,K-1,KK)   INTRP136
    GO TO 570                                                           INTRP137
570 CONTINUE                                                            INTRP138
580 CONTINUE                                                            INTRP139
    DO 600 I = 1,NI                                                     INTRP140
    DO 590 J = 2,NJ                                                     INTRP141
    IJ = IJS+(J-1)*NIP2+I                                               INTRP142
590 L(IJ) = MIN0(L(IJ),1)                                               INTRP143
    W(IJS+NIP2+I,3) = 0.0                                               INTRP144
    W(IJS+NIP2+I,6) = 0.                                                INTRP145
    W(IJS+I,1) = W(IJS+2*NIP2+I,1)                                      INTRP146
    W(IJS+I,2) = W(IJS+2*NIP2+I,2)                                      INTRP147
    W(IJS+I,3) = -W(IJS+2*NIP2+I,3)                                     INTRP148
    W(IJS+I,4) = W(IJS+2*NIP2+I,4)                                      INTRP149
    W(IJS+I,5) = W(IJS+2*NIP2+I,5)                                      INTRP150
    W(IJS+I,6) = -W(IJS+2*NIP2+I,6)                                     INTRP151
    W(IJS+I,7) = W(IJS+2*NIP2+I,7)                                      INTRP152
600 L(IJS+I) = L(IJS+2*NIP2+I)                                          INTRP153
    RETURN                                                              INTRP154
    END                                                                 INTRP155
```

```
      SUBROUTINE IPOSN                                                  IPOSN   2
      COMMON// W(2200,7),L(2200)                                        INTVAL  2
      COMMON/BNDCRS/ WBI(109,8,7),PBI(109,8),IND(109,9),                BNDCRS  2
     1WBJ(78,8,7),PBJ(78,8),JND(78,9)                                   BNDCRS  3
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,ML,YC,RHO,XO,PO,TO,XZ,A,B,ABL,DMATVAL  2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SBL,AL,AS,AK,HAL,HAS,HAK,GAL,GAS,GAK,DAXMATVAL  3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTRMU,FRTRMU,QOVMMATVAL  4
     3O,IREQTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSB,NIM1,NJM1,ND,ND1,NE,NE1MATVAL  5
     4,NF,NIP2,NTR                                                      MATVAL  6
      DO 60 J = 2,NJ                                                    IPOSN   6
      JJ = IJS+(J-1)*NIP2                                               IPOSN   7
      I2 = 0                                                            IPOSN   8
      N = JND(JS+J,1)                                                   IPOSN   9
      IF (N.EQ.0) GO TO 50                                              IPOSN  10
      DO 40 K = 2,N,2                                                   IPOSN  11
      I1 = I2+1                                                         IPOSN  12
      I2 = INT(PBJ(JS+J,K-1)*DAX)+1                                     IPOSN  13
      IF (I1.GT.I2) GO TO 20                                            IPOSN  14
      DO 10 I = I1,I2                                                   IPOSN  15
      IJ = JJ+I                                                         IPOSN  16
   10 L(IJ) = 0                                                         IPOSN  17
   20 I1 = I2+1                                                         IPOSN  18
      I2 = INT(PBJ(JS+J,K)*DAX)+1                                       IPOSN  19
      IF (I1.GT.I2) GO TO 40                                            IPOSN  21
      DO 30 I = I1,I2                                                   IPOSN  21
      IJ = JJ+I                                                         IPOSN  22
      IF (L(IJ).GT.1) GO TO 30                                          IPOSN  23
      L(IJ) = 2-L(IJ)                                                   IPOSN  24
   30 CONTINUE                                                          IPOSN  25
   40 CONTINUE                                                          IPOSN  26
   50 I1 = I2+1                                                         IPOSN  27
      DO 60 I = I1,NI                                                   IPOSN  28
      IJ = JJ+I                                                         IPOSN  29
   60 L(IJ) = 0                                                         IPOSN  30
      DO 90 I = 1,NI                                                    IPOSN  31
      J1 = 2                                                            IPOSN  32
      N = IND(IS+I,1)                                                   IPOSN  33
      IF (N.NE.0) J1 = INT(PBI(IS+I,N)*DAY)+3                           IPOSN  34
      DO 70 J = J1,NJ                                                   IPOSN  35
      IJ = IJS+(J-1)*NIP2+I                                             IPOSN  36
   70 L(IJ) = 0                                                         IPOSN  37
      IF (N.LE.1) GO TO 90                                              IPOSN  38
      K = N                                                             IPOSN  39
      DO 80 KK = 2,N,2                                                  IPOSN  40
      K = K-2                                                           IPOSN  41
      J1 = 2                                                            IPOSN  42
      IF (K.NE.0) J1 = INT(PBI(IS+I,K)*DAY)+3                           IPOSN  43
      J2 = INT(PBI(IS+I,K+1)*DAY)+2                                     IPOSN  44
      IF (J1.GT.J2) GO TO 90                                            IPOSN  45
      DO 80 J = J1,J2                                                   IPOSN  46
      IJ = IJS+(J-1)*NIP2+I                                             IPOSN  47
   80 L(IJ) = 0                                                         IPOSN  48
   90 CONTINUE                                                          IPOSN  49
      RETURN                                                            IPOSN  50
      END                                                               IPOSN  51
```

```
      SUBROUTINE PRNPLT                                                 PRNPLT 2
      COMMON /BNDVAL/ WB(600,7),FBX(600),FBY(600),FBS(600)             BNDVAL 2
      COMMON/SCRTCH/ TWB(300,7),TFBX(300),TFBY(300)                     SCRTCH 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      XS = 1.0/PSCL                                                     PRNPLT 8
      YS = XS                                                           PRNPLT 9
      CALL PRNT (-XS*PORG,5.0,-3)                                       PRNPLT10
      DO 40 MAT = 1,NMAT                                                PRNPLT11
      NF = NEND(MAT,3)                                                  PRNPLT12
      IBS = IMAT(7,MAT)                                                 PRNPLT13
      X0 = FMAT(9,MAT)                                                  PRNPLT14
      YZ=FMAT(11,MAT)                                                   OFAX  38
      XZ = FMAT(12,MAT)                                                 PRNPLT15
      A = FMAT(13,MAT)                                                  PRNPLT16
      B = FMAT(14,MAT)                                                  PRNPLT17
      CHAN = FMAT(17,MAT)                                               PRNPLT18
      BMAX = FMAT(18,MAT)                                               PRNPLT19
      ANG = FMAT(20,MAT)                                                PRNPLT20
      AF = FMAT(21,MAT)                                                 PRNPLT21
      DO 10 I = 1,NF                                                    PRNPLT22
      CH=CHAN**(BMAX-FBY(IBS+I)+YZ)                                     OFAX  39
      TFBY(I) = A-B*(CH-1.0)/(CH+1.0)                                   PRNPLT24
      TFBX(I) = X0+(FBX(IBS+I)-XZ)+ANG*TFBY(I)*TOP*ATAN(AF*TFBY(I))     PRNPLT25
      TFBX(I) = XS*TFBX(I)                                              PRNPLT26
   10 TFBY(I) = YS*TFBY(I)                                              PRNPLT27
      CALL PRNT (TFBX,TFBY,3)                                           PRNPLT28
      DO 20 I = 2,NF                                                    PRNPLT29
      X = TFBX(I)                                                       PRNPLT30
      Y = TFBY(I)                                                       PRNPLT31
   20 CALL PRNT (X,Y,2)                                                 PRNPLT32
      CALL PRNT (TFBX,TFBY,3)                                           PRNPLT33
      DO 30 I = 2,NF                                                    PRNPLT34
      X = TFBX(I)                                                       PRNPLT35
      Y = -TFBY(I)                                                      PRNPLT36
   30 CALL PRNT (X,Y,2)                                                 PRNPLT37
   40 CONTINUE                                                          PRNPLT38
      CALL FRAME                                                        PRNPLT39
      WRITE (6,50) AKT,KT                                               PRNPLT40
      RETURN                                                            PRNPLT41
                                                                        PRNPLT42
   50 FORMAT (1H0,45X,2HT=,E12.5,5X,I4,7H CYCLES/1H1)                   PRNPLT43
      END                                                               PRNPLT44
```

```
      SUBROUTINE PLTOUT                                                 PLTOUT 2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON/SCRTCH/ TWB(300,7),TFRX(300),TFRY(300)                     SCRTCH 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIER,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /MATVAL/ AX,AY,CFL,VIC,VIST,MU,YC,RHO,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ABL,CHAN,BMAX,FACT,ANG,AF,SRH,AL,AS,AK,HAL,HAS,HAK,QAL,QAS,QAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTOMU,FRTOMU,OOVMMATVAL 4
     30,IREDTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSR,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      EQUIVALENCE(YZ,T0)                                                OFAX  40
      DO 60 MAT = 1,NMAT                                                PLTOUT11
      CALL GENVAL                                                       PLTOUT12
      DO 10 I = 1,NF                                                    PLTOUT13
      CH=CHAN**(BMAX-FRY(IBS+I)+Y7)                                     OFAX  41
      TFRY(I) = A-B*(CH-1.0)/(CH+1.0)                                   PLTOUT15
      TFRX(I) = X0+(FRX(IBS+I)-XZ)+ANG*TFRY(I)*TOP*ATAN(AF*TFRY(I))     PLTOUT16
   10 CONTINUE                                                          PLTOUT17
      DO 20 I = 1,NTR                                                   PLTOUT18
      J = ITR(MAT,I)                                                    PLTOUT19
      TRZ = FRX(IBS+J)+TRS(MAT,I)*(FRX(IBS+J+1)-FRX(IBS+J))             PLTOUT20
      TRR = FRY(IBS+J)+TRS(MAT,I)*(FRY(IBS+J+1)-FRY(IBS+J))             PLTOUT21
      TWB(I,2) = WB(IBS+J,2)+TRS(MAT,I)*(WB(IBS+J+1,2)-WB(IBS+J,2))     PLTOUT22
      TWB(I,3) = WB(IBS+J,3)+TRS(MAT,I)*(WB(IBS+J+1,3)-WB(IBS+J,3))     PLTOUT23
      CH=CHAN**(BMAX-TRR+YZ)                                            OFAX  42
      TWB(I,1) = A-B*(CH-1.0)/(CH+1.0)                                  PLTOUT25
   20 TWB(I+100,1) = X0+(TRZ-XZ)+ANG*TWB(I,1)*TOP*ATAN(AF*TWB(I,1))     PLTOUT26
      IF (MAT.NE.1) GO TO 30                                            PLTOUT27
      WRITE(2) AKT,NMAT,NF,(TFRX(I),TFRY(I),I=1,NF),NTR,(TWB(I+100,1),  PLTOUT28
     1TWB(I,1),I=1,NTR),(TWB(I,2),TWB(I,3),I=1,NTR)                     PLTOUT29
      GO TO 40                                                          PLTOUT30
   30 CONTINUE                                                          PLTOUT31
      WRITE (2) NF,(TFRX(I),TFRY(I),I = 1,NF),NTR,(TWB(I+100,1),TWB(I,1)PLTOUT32
     1,I = 1,NTR),(TWB(I,2),TWB(I,3),I = 1,NTR)                         PLTOUT33
   40 CONTINUE                                                          PLTOUT34
      YCM = 0.99*YC                                                     PLTOUT35
      N = 0                                                             PLTOUT36
      DO 50 J = 2,NJ                                                    PLTOUT37
      JJ = IJS*(J-1)*NIP2                                               PLTOUT38
      DO 50 I = 1,NI                                                    PLTOUT39
      IF (L(JJ+I).EQ.0) GO TO 50                                        PLTOUT40
      YIELD = W(JJ+I,5)**2+W(JJ+I,6)**2+W(JJ+I,7)**2+W(JJ+I,5)*W(JJ+I,7)PLTOUT41
      IF (YIELD.LT.YCM) GO TO 50                                        PLTOUT42
      N = N+1                                                           PLTOUT43
      TRZ = FLOAT(I-1)*AX                                               PLTOUT44
      TRR = FLOAT(J-2)*AY                                               PLTOUT45
      CH=CHAN**(BMAX-TRR+YZ)                                            OFAX  43
      TFRY(N) = A-B*(CH-1.0)/(CH+1.0)                                   PLTOUT47
      TFRX(N) = X0+(TRZ-X7)+ANG*TFRY(N)*TOP*ATAN(AF*TFRY(N))            PLTOUT48
      IF (N.LT.100) GO TO 50                                            PLTOUT49
      WRITE (2) N,(TFRX(K),TFRY(K),K = 1,N)                             PLTOUT50
```

```
      N = 0                                                          PLTOUT51
   50 CONTINUE                                                       PLTOUT52
      WRITE (2) N,(TFRX(K),TFRY(K),K = 1,N)                          PLTOUT53
   60 CONTINUE                                                       PLTOUT54
      RETURN                                                         PLTOUT55
      END                                                            PLTOUT56
```

```
      SUBROUTINE OUTPUT                                                 OTPT   2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON/BNDCRS/ WBI(109,8,7),PRI(109,8),IND(109,9),                BNDCRS 2
     1WBJ(78,8,7),PRJ(78,8),JND(78,9)                                   BNDCRS 3
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /MATVAL/ AX,AY,CFL,VIS,VIST,MU,YC,RH0,X0,P0,T0,XZ,A,B,ABL,DMATVAL 2
     1ARL,CHAN,RMAX,FACT,ANG,AF,SBM,AL,AS,AK,HAL,HAS,HAK,GAL,GAS,GAK,DAXMATVAL 3
     2,DAY,HDAX,HDAY,DAX2,DAY2,HDAXY,QDAXY,DTR,HALFMU,TWTDMU,FRTDMU,OOVMMATVAL 4
     3U,IREOTM,NI,NJ,NFMAX,IS,JS,IJS,IBS,ISB,JSP,NIM1,NJM1,ND,ND1,NE,NE1MATVAL 5
     4,NF,NIP2,NTR                                                      MATVAL 6
      COMMON /TVALS/ ISTART,TMAX,TPRIN,TPRPL,TPLOT,TSAVE,TCOMP,TZ       TVALS  2
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IFOINT,EPP,EPS,EPS1,RDICOMVAL 2
     1S,IOP,DAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      COMMON /PRESS/ PDER,PR,PE,MATNO                                   PRESS  2
      DIMENSION WOUT(8)                                                 OTPT   13
      EQUIVALENCE(YZ,T0)                                                OFAX   44
      LOGICAL PDER                                                      OTPT   14
      R(Y)=A-B*(CHAN**(RMAX-Y+YZ)-1.0)/(CHAN**(RMAX-Y+YZ)+1.0)          OFAX   45
      Z(X,Y) = X0+(X-XZ)+ANG*Y+TOP*ATAN(AF*Y)                           OTPT   16
      PDER = .FALSE.                                                    OTPT   17
      DO 100 MAT = 1,NMAT                                               OTPT   18
      IPRINT = IMAT(11,MAT)                                             OTPT   19
      JPRINT = IMAT(12,MAT)                                             OTPT   20
      IF (MAT.NE.1) GO TO 10                                            OTPT   21
      CALL SECOND (T1)                                                  OTPT   22
      RT = T1-TZ                                                        OTPT   23
      WRITE (6,170) AKT,DT,KT,RT                                        OTPT   24
      GO TO 20                                                          OTPT   25
   10 WRITE (6,130) MAT                                                 OTPT   26
   20 CALL GENVAL                                                       OTPT   27
      WRITE (6,120)                                                     OTPT   28
      ZMIN = 1.0E6                                                      OTPT   29
      RMIN = ZMIN                                                       OTPT   30
      ZMAX = -ZMIN                                                      OTPT   31
      RMAX = ZMAX                                                       OTPT   32
      DO 40 I = 1,NF                                                    OTPT   33
      ZMIN = AMIN1(FRX(IBS+I),ZMIN)                                     OTPT   34
      ZMAX = AMAX1(FRX(IBS+I),ZMAX)                                     OTPT   35
      RMIN = AMIN1(FRY(IBS+I),RMIN)                                     OTPT   36
      RMAX = AMAX1(FRY(IBS+I),RMAX)                                     OTPT   37
      RR = R(FRY(IBS+I))                                                OTPT   3
      ZZ = Z(FRX(IBS+I),RR)                                             OTPT   39
      DO 30 KK = 1,7                                                    OTPT   40
   30 WOUT(KK) = WB(IBS+I,KK)                                           OTPT   41
      WOUT(8) = PRS(WOUT(1),WOUT(4))+P0                                 OTPT   42
      WOUT(1) = WOUT(1)+RH0                                             OTPT   43
      WOUT(5) = WOUT(5)+P0                                              OTPT   44
      WOUT(6) = WOUT(6)+P0                                              OTPT   45
      WOUT(7) = WOUT(7)+P0                                              OTPT   46
   40 WRITE (6,140) I,ZZ,RR,WOUT                                        OTPT   47
      IF (IPRINT.EQ.0.OR.JPRINT.EQ.0) GO TO 70                          OTPT   48
      IB = INT(ZMIN*DAX)+2                                              OTPT   49
      IE = INT(ZMAX*DAX)+1                                              OTPT   50
```

```
      IF (IPRINT.GT.0) IE = MIN0(IF+IPRINT-1,IE)                        OTPT  51
      IF (IPRINT.LT.0) IB = MAX0(IE+IPRINT+1,IB)                        OTPT  52
      JB = INT(RMIN*DAY)+2                                              OTPT  53
      JE = INT(RMAX*DAY)+2                                              OTPT  54
      IF (JPRINT.GT.0) JE = MIN0(JF+JPRINT-1,JE)                        OTPT  55
      IF (JPRINT.LT.0) JB = MAX0(JF+JPRINT+1,JB)                        OTPT  56
      WRITE (6,150)                                                     OTPT  57
      DO 60 J = JB,JE                                                   OTPT  58
      WRITE(6,190) J                                                    OTPTC1  1
      RR = R(FLOAT(J-2)*AY)                                             OTPT  59
      JJ = IJS*(J-1)+NIP2                                               OTPT  60
      DO 60 I = IB,IE                                                   OTPT  61
      IF (L(JJ+I),EQ.0) GO TO 60                                        OTPT  62
      ZZ = Z(FLOAT(I-1)*AX,RR)                                          OTPT  63
      DO 50 KK = 1,7                                                    OTPT  64
   50 WOUT(KK) = W(JJ+I,KK)                                             OTPT  65
      WOUT(8) = PRS(WOUT(1),WOUT(4))*P0                                 OTPT  66
      WOUT(1) = WOUT(1)*RW0                                             OTPT  67
      WOUT(5) = WOUT(5)*P0                                              OTPT  68
      WOUT(6) = WOUT(6)*P0                                              OTPT  69
      WOUT(7) = WOUT(7)*P0                                              OTPT  70
      WRITE (6,140) I,ZZ,RR,WOUT                                        OTPT  71
   60 CONTINUE                                                          OTPT  72
   70 WRITE (6,160)                                                     OTPT  73
      DO 90 I = 1,NTR                                                   OTPT  74
      J = ITR(MAT,I)                                                    OTPT  75
      TRZ = FRX(IBS+J)+TRS(MAT,I)*(FRX(IBS+J+1)-FRX(IBS+J))             OTPT  76
      TRR = FRY(IBS+J)+TRS(MAT,I)*(FRY(IBS+J+1)-FRY(IBS+J))             OTPT  77
      DO 80 KK = 1,KMAX                                                 OTPT  78
   80 WOUT(KK) = WB(IBS+J,KK)+TRS(MAT,I)*(WB(IBS+J+1,KK)-WB(IBS+J,KK))  OTPT  79
      RR = R(TRR)                                                       OTPT  80
      ZZ = Z(TRZ,RR)                                                    OTPT  81
      WOUT(8) = PRS(WOUT(1),WOUT(4))*P0                                 OTPT  82
      WOUT(1) = WOUT(1)*RW0                                             OTPT  83
      WOUT(5) = WOUT(5)*P0                                              OTPT  84
      WOUT(6) = WOUT(6)*P0                                              OTPT  85
      WOUT(7) = WOUT(7)*P0                                              OTPT  86
   90 WRITE (6,140) I,ZZ,RR,WOUT                                        OTPT  87
  100 CONTINUE                                                          OTPT  88
      DO 110 I = 1,NINFC                                                OTPT  89
      JE = 6*I                                                          OTPT  90
      JB = JE-5                                                         OTPT  91
  110 WRITE (6,180) (INFC(J),J = JB,JE)                                 OTPT  92
      RETURN                                                            OTPT  93
C                                                                       OTPT  94
  120 FORMAT (1H0/5H0 PT,6X1HZ9X1HR9X3HRHO11X1HU12X1HV12X1HE11X3HSZZ10X3OTPT  95
     1HSZR10X3HSRR11X1HP/1H09X3HCMS7X3HCMS7X5HGRAMS9X3HCMS10X3HCMS6X11H1OTPTC1  2
     20**12 ERGS2X12H10**12 DYNES1X12H10**12 DYNES1X12H10**12 DYNES1X12HOTPTC1  3
     310**12 DYNES/30X5HCM**37X8HMICROSEC9X8HMICROSEC6X4HGRAM9X5HCM**28XOTPTC1  4
     45HCM**28X5HCM**28X5HCM  2//)                                      OTPTC1  5
  130 FORMAT (1H1//58X8HMATERIAL12)                                     OTPT  97
  140 FORMAT (I5,2F10.4,8E13.5)                                         OTPT  98
  150 FORMAT (1H0/55X15HINTERIOR POINTS)                                OTPT  99
  160 FORMAT (1H0/54X16HTRACER PARTICLES)                               OTPT 100
  170 FORMAT (1H1/3H0T=E12.5,5X3HDT=E12.5,5X14,7H CYCLES5X13HELAPSED TIMOTPT 101
     1E=F8.3/3X12HMICROSECONDS8X12HMICROSECONDS35X7HSECONDS//1H057X10HMAOTPTC1  6
```

```
   2TERIAL 1)                                                          OTPTC1 7
180 FORMAT (9H0MATERIAL12,11H FROM POINT14,9H TO POINT14,31H HAS AN INOTPT 103
   1TERFACE WITH MATERIAL12,11H FROM POINT14,9H TO POINT14)            OTPT 104
190 FORMAT(1H059X13)                                                   OTPTC1 8
    END                                                                OTPT 105
```

```
      SUBROUTINE SAVE                                                   SAVE   2
      COMMON// W(2200,7),L(2200)                                        INTVAL 2
      COMMON /BNDVAL/ WB(600,7),FRX(600),FRY(600),FRS(600)              BNDVAL 2
      COMMON/SCRTCH/ TWB(300,7),TFRX(300),TFRY(300)                     SCRTCH 2
      COMMON /ZONES/ NBEG(5,3),NEND(5,3),ARCSIZ(5,3),DISMAX(5,3),DISMIN(ZONES  2
     15,3)                                                              ZONES  3
      COMMON /MATARR/ NMAT,IMAT(12,5),FMAT(23,5),MAT                    MATARR 2
      COMMON /COMVAL/ KT,AKT,DT,DTMIN,ITER,NEIBR,IPOINT,ERR,EPS,EPS1,RDICOMVAL 2
     1S,TOP,BAL,KMAX,PORG,PSCL,LB,LF                                    COMVAL 3
      COMMON /TRCPRT/ NTRS(5),ITR(5,25),TRS(5,25)                       TRCPRT 2
      COMMON /INTFC/ NINFC,INFC(60),NONIN(20,5)                         INTFC  2
      REWIND 1                                                          SAVE  11
      WRITE (1) KT,AKT,DTMIN                                            SAVE  12
      NIN6 = 6*NINFC                                                    SAVE  13
      WRITE (1) NINFC,NIN6,(INFC(I),I = 1,NIN6)                         SAVE  14
      DO 30 MAT = 1,NMAT                                                SAVE  15
      NTR = NTRS(MAT)                                                   SAVE  16
      NF = NEND(MAT,3)                                                  SAVE  17
      NI = IMAT(1,MAT)                                                  SAVE  18
      NIP2 = NI+2                                                       SAVE  19
      IJS = IMAT(6,MAT)                                                 SAVE  20
      IBS = IMAT(7,MAT)                                                 SAVE  21
      AX = FMAT(1,MAT)                                                  SAVE  22
      DAX = 1.0/AX                                                      SAVE  23
      AY=FMAT(2,MAT)                                                    OFAX  46
      DAY=1.0/AY                                                        OFAX  47
      YZ=FMAT(11,MAT)                                                   OFAX  48
      XZ = FMAT(12,MAT)                                                 SAVE  25
      ZMIN = 1.0E6                                                      SAVE  26
      RMIN = ZMIN                                                       SAVE  27
      ZMAX = -ZMIN                                                      SAVE  28
      RMAX = ZMAX                                                       SAVE  29
      DO 10 I = 1,NF                                                    SAVE  30
      ZMIN = AMIN1(FRX(IBS+I),ZMIN)                                     SAVE  31
      ZMAX = AMAX1(FRX(IBS+I),ZMAX)                                     SAVE  32
      RMIN = AMIN1(FRY(IBS+I),RMIN)                                     SAVE  33
   10 RMAX = AMAX1(FRY(IBS+I),RMAX)                                     SAVE  34
      IB=INT(ZMIN*DAX)+2                                                SAVEC1  1
      IE=INT(ZMAX*DAX)+1                                                SAVEC1  2
      JB=INT(RMIN*DAY)+3                                                OFAX  49
      IF(RMIN.LE.1.0E-4) JB=1                                           OFAX  50
      JE=INT(RMAX*DAY)+2                                                SAVEC1  4
      NI = IE-IB+1                                                      SAVE  39
      NJ = JE-JB+1                                                      SAVE  40
      ZDF = FLOAT(1-IB)*AX                                              SAVE  41
      XZ = XZ+ZDF                                                       SAVE  42
      RDF=FLOAT(1-JB)*AY                                                OFAX  51
      YZ=YZ+RDF                                                         OFAX  52
      DO 20 I = 1,NF                                                    SAVE  43
      TFRY(I)=FRY(IBS+I)+RDF                                            OFAX  53
   20 TFRX(I) = FRX(IBS+I)+ZDF                                          SAVE  44
      WRITE (1) (NBEG(MAT,I),NEND(MAT,I),ARCSIZ(MAT,I),I = 1,3),XZ,NI,NJSAVE  45
     1,NF,YZ                                                            OFAX  54
      IT1=IBS+1                                                         SAVEC1  6
      IT2=IBS+NF                                                        SAVEC1  7
      WRITE(1) ((WB(I,KK),KK=1,KMAX),FRS(I),I=IT1,IT2),(TFRX(I),TFRY(I),SAVEC1  8
```

```
      1I=1,NF),FMAT(22,MAT)                                              SAVEC1  9
        WRITE (1) NTR,(ITR(MAT,I),THS(MAT,I),I = 1,NTR)                  SAVE   49
        DO 25 J=JB,JE                                                    SAVEC110
        JJ=IJS+(J-1)*NIP2                                                SAVEC111
        IT1=JJ+IB                                                        SAVEC112
        IT2=JJ+IE                                                        SAVEC113
   25   WRITE(1) ((W(I,KK),KK=1,KMAX),L(I),I=IT1,IT2)                    SAVEC114
   30   CONTINUE                                                         SAVE   52
        END FILE 1                                                       SAVE   53
        RETURN                                                           SAVE   54
        END                                                              SAVE   55
```

```
      SUBROUTINE FRAME                                                  FRME    2
      COMMON /COMPLT/ IX0,IY0,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLAFRME    3
     1G,XS,YS                                                           FRME    4
      DIMENSION L(121), ICHAR(37)                                       FRME    5
      LOGICAL IPEN,FLAG                                                 FRME    6
      DATA IBLNK/1H /                                                   FRME    7
      DATA ICHAR/1H*,1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HMFRME    8
     1,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,1H0,1H1,1H2,1FRME    9
     2H3,1H4,1H5,1H6,1H7,1H8,1H9/                                       FRME   10
      WRITE (6,50)                                                      FRME   11
      N = 1                                                             FRME   12
      JT = IMAX*JMAX                                                    FRME   13
      DO 30 I = 1,IMAX                                                  FRME   14
      JT = JT-JMAX                                                      FRME   15
      DO 10 J = 1,JMAX                                                  FRME   16
   10 L(J) = IBLNK                                                      FRME   17
   20 MN = M(N)/64                                                      FRME   18
      IF (MN.LT.JT) GO TO 30                                            FRME   19
      JJ = MN-JT                                                        FRME   20
      K = M(N)-MN*64                                                    FRME   21
      L(JJ) = ICHAR(K+1)                                                FRME   22
      N = N+1                                                           FRME   23
      IF (N.LE.NP) GO TO 20                                             FRME   24
      WRITE (6,60) L                                                    FRME   25
      GO TO 40                                                          FRME   26
   30 WRITE (6,60) L                                                    FRME   27
   40 CALL RESET                                                        FRME   28
      RETURN                                                            FRME   29
C                                                                       FRME   30
   50 FORMAT (1H1)                                                      FRME   31
   60 FORMAT (1H ,121A1)                                                FRME   32
      END                                                               FRME   33
```

```
      SUBROUTINE PRNTS (N,M)                                        PLTS  2
      CALL RESET                                                    PLTS  3
      RETURN                                                        PLTS  4
      END                                                           PLTS  5
```

```
      SUBROUTINE RESET                                                  RSET    2
      COMMON /COMPLT/ IXO,IYO,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLARSET    3
     1G,XS,YS                                                           RSET    4
      LOGICAL IPEN,FLAG                                                 RSET    5
      IXO = 1                                                           RSET    6
      IYO = 1                                                           RSET    7
      IXN = 1                                                           RSET    8
      IYN = 1                                                           RSET    9
      IPEN = .TRUE.                                                     RSET   10
      FLAG = .TRUE.                                                     RSET   11
      NP = 0                                                            RSET   12
      RETURN                                                            RSET   13
      END                                                               RSET   14
```

```
      SUBROUTINE PRNT (X,Y,JP)                                          PRNT    2
      COMMON /COMPLT/ IX0,IY0,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLAPRNT    3
     1G,XS,YS                                                           PRNT    4
      LOGICAL IPEN,FLAG                                                 PRNT    5
      IX = IFIX(XS*X)+IX0                                               PRNT    6
      IY = IFIX(YS*Y)+IY0                                               PRNT    7
      IP = JP                                                           PRNT    8
      IF (IABS(IP).EQ.2) IPEN = .TRUE.                                  PRNT    9
      IF (IABS(IP).EQ.3) IPEN = .FALSE.                                 PRNT   10
      IF (.NOT.IPEN) GO TO 40                                           PRNT   11
      IF = MIN0(IY,IYN)                                                 PRNT   12
      IL = MAX0(IY,IYN)                                                 PRNT   13
      JF = MIN0(IX,IXN)                                                 PRNT   14
      JL = MAX0(IX,IXN)                                                 PRNT   15
      IF (IF.GT.IMAX.OR.IL.LT.1.OR.JF.GT.JMAX.OR.JL.LT.1) GO TO 40      PRNT   16
      IDX = IX-IXN                                                      PRNT   17
      IDY = IY-IYN                                                      PRNT   18
      IF (IABS(IDX).GT.IABS(IDY)) GO TO 20                              PRNT   19
      IF (IDY.EQ.0) GO TO 40                                            PRNT   20
      IF = MAX0(IF,1)                                                   PRNT   21
      IL = MIN0(IL,IMAX)                                                PRNT   22
      DO 10 I = IF,IL                                                   PRNT   23
      J = IXN+(IDX*(I-IYN))/IDY                                         PRNT   24
      IF (J.LT.1.OR.J.GT.JMAX) GO TO 10                                 PRNT   25
      CALL SETPT (I,J,0)                                                PRNT   26
      IF (.NOT.FLAG) GO TO 40                                           PRNT   27
   10 CONTINUE                                                          PRNT   28
      GO TO 40                                                          PRNT   29
   20 CONTINUE                                                          PRNT   30
      JF = MAX0(JF,1)                                                   PRNT   31
      JL = MIN0(JL,JMAX)                                                PRNT   32
      DO 30 J = JF,JL                                                   PRNT   33
      I = IYN+(IDY*(J-IXN))/IDX                                         PRNT   34
      IF (I.LT.1.OR.I.GT.IMAX) GO TO 30                                 PRNT   35
      CALL SETPT (I,J,0)                                                PRNT   36
      IF (.NOT.FLAG) GO TO 40                                           PRNT   37
   30 CONTINUE                                                          PRNT   38
   40 IXN = IX                                                          PRNT   39
      IYN = IY                                                          PRNT   40
      IF (IP.GT.0) RETURN                                               PRNT   41
      IX0 = IXN                                                         PRNT   42
      IY0 = IYN                                                         PRNT   43
      RETURN                                                            PRNT   44
      END                                                               PRNT   45
```

```
      SUBROUTINE SETPT (I,J,ICHR)                                        STPT    2
      COMMON /COMPLT/ IX0,IY0,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLASTPT    3
     1G,XS,YS                                                            STPT    4
      LOGICAL IPEN,FLAG                                                  STPT    5
      N = (JMAX*(I-1)+J)*64                                              STPT    6
      CALL SEEK (M,NP,N,K)                                               STPT    7
      IF (K.GT.0) RETURN                                                 STPT    8
      NP = NP+1                                                          STPT    9
      IF (NP.GT.MAXP) GO TO 30                                           STPT   10
      K = -K+1                                                           STPT   11
      IF (K.GT.NP) GO TO 20                                              STPT   12
      LL = NP                                                            STPT   13
      DO 10 L = K,NP                                                     STPT   14
      LL = LL-1                                                          STPT   15
   10 M(LL+1) = M(LL)                                                    STPT   16
   20 M(K+1) = N+ICHR                                                    STPT   17
      RETURN                                                             STPT   18
   30 NP = NP-1                                                          STPT   19
      IF (FLAG) WRITE (6,40) NP                                          STPT   20
      FLAG = .FALSE.                                                     STPT   21
      RETURN                                                             STPT   22
C                                                                        STPT   23
   40 FORMAT (1H1///25H0ATTEMPT TO SET MORE THAN16,38H PRNT POINTS, REMASTPT   24
     1INING POINTS IGNORED)                                              STPT   25
      END                                                                STPT   26
```

```
      SUBROUTINE SMBOL (X,Y,ISYMB)                                      SMBL    2
      COMMON /COMPLT/ IX0,IY0,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLASMBL    3
     1G,XS,YS                                                           SMBL    4
      LOGICAL IPEN,FLAG                                                 SMBL    5
      IXN = IFIX(XS*X)+IX0                                              SMBL    6
      IYN = IFIX(YS*Y)+IY0                                              SMBL    7
      IF (IXN.LT.1.OR.IXN.GT.JMAX.OR.IYN.LT.1.OR.IYN.GT.IMAX) RETURN    SMBL    8
      CALL SETPT (IYN,IXN,ISYMB)                                        SMBL    9
      RETURN                                                            SMBL   10
      END                                                               SMBL   11
```

```
      SUBROUTINE SEEK (A,NP,PP,K)                                    SEEK   2
      DIMENSION A(1)                                                 SEEK   3
      INTEGER A,P,PP                                                 SEEK   4
      IT = NP                                                        SEEK   5
      IF (IT.EQ.0) GO TO 30                                          SEEK   6
      IB = 1                                                         SEEK   7
      P = PP                                                         SEEK   8
      IF ((P-A(1))/64) 10,20,30                                      SEEK   9
   10 IF ((P-A(IT))/64) 40,50,60                                     SEEK  10
   20 I = 1                                                          SEEK  11
      GO TO 100                                                      SEEK  12
   30 I = -1                                                         SEEK  13
      GO TO 100                                                      SEEK  14
   40 I = -IT-1                                                      SEEK  15
      GO TO 100                                                      SEEK  16
   50 I = IT                                                         SEEK  17
      GO TO 100                                                      SEEK  18
   60 IF (IT-IB.EQ.1) GO TO 90                                       SEEK  19
      I = (IB+IT)/2                                                  SEEK  20
      IF ((P-A(I))/64) 70,100,80                                     SEEK  21
   70 IB = I                                                         SEEK  22
      GO TO 60                                                       SEEK  23
   80 IT = I                                                         SEEK  24
      GO TO 60                                                       SEEK  25
   90 I = -IT                                                        SEEK  26
  100 K = I                                                          SEEK  27
      RETURN                                                         SEEK  28
      END                                                            SEEK  29
```

```
      BLOCK DATA                                                        BKDT    2
      COMMON /COMPLT/ IX0,IY0,IXN,IYN,IPEN,IMAX,JMAX,NP,MAXP,M(2000),FLABKDT    3
     1G,XS,YS                                                          BKDT    4
      DATA IMAX,JMAX,MAXP/61,121,2000/                                  BKDT    5
      DATA XS,YS/10.0001,6.0001/                                        BKDT    6
      END                                                               BKDT    7
```

```
      FUNCTION PRS (RHOO,EE)                                                PRS     2
      COMMON /PRESS/ PDER,PR,PE,MATNO                                       PRESS   2
      COMMON /EOSTP/ APL(10),BPL(10),APB(10),BPB(10),ALPH(10),BETA(10),EEOSTP  2
     1S(10),EZERO(10),ESPRM(10),RHOZRO(10),PMIN(10)                         EOSTP   3
      LOGICAL MIN                                                           PRS     5
      LOGICAL PDER                                                          PRS     6
      REAL MU                                                               PRS     7
      DATA APL,BPL,APB,BPB,ALPH,BETA,RHOZRO,EZERO,ES,ESPRM,PMIN/0.5,0.5,PRS     8
     10,5,0.5,0.5,0.5,0.0,0.0,0.0,0.0,0.0,0.0,1.50,1.04,1.50,1.10,1.63,0.0,0.0,0.0,0PRS     9
     2,0.0,0.0,0.0,0.0,1.28,3.08,1.28,.068,0.75,0.0,0.0,0.0,0.0,0.0,0.0,0.0,1.05,2.50,PRS    10
     31.05,0.04,0.65,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,5.0,10.0,5.0,5.0,5.0,5.0,0.0,0.0,0.0,0.PRS    11
     40.0,0.0,0.5,0.10,0.5,0.5,0.5,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,7.8,17.04,8.0,1PRS    12
     5,694,2.79,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.095,0.225,0.095,0.060,0.05,0.0,0.0,0PRS    13
     6,0.0,0.0,0.0,0.0,0.0244,0.0111,0.0244,0.0320,0.03,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.PRS    14
     70,102,0.056,0.102,0.180,0.15,0.0,0.0,0.0,0.0,0.0,0.0,0.0,-0.035,-0.00371,-PRS    15
     80,035,-0.0033,-0.035,0.0,0.0,0.0,0.0,0.0,0.0,0.0/                    PRS    16
C       MAT(1)=TARGET, MAT(2)=PROJ , MAT(3)=PROJ SHEATH                     PRS    17
C                                                                           PRS    18
      MAT = MATNO                                                           PRS    19
      ETA = RHOO                                                            PRS    20
      IF (ETA.GT.0.0) GO TO 10                                              PRS    21
      ETA = -ETA                                                            PRS    22
      MIN = .FALSE.                                                         PRS    23
      GO TO 20                                                              PRS    24
   10 MIN = .TRUE.                                                          PRS    25
   20 CONTINUE                                                              PRS    26
      E = EE                                                                PRS    27
      R = ETA*RHOZRO(MAT)                                                   PRS    28
      MU = ETA-1.0                                                          PRS    29
      IF(ABS(MU).LT.1.0E-6) MU=0.0                                          PRS    30
      EX = BPL(MAT)/(E/(EZERO(MAT)*ETA**2)+1.0)                             PRS    31
      IF (ETA.GE.1.0.OR.E.LE.ES(MAT)) GO TO 30                              PRS    32
      IF (E.GE.ESPRM(MAT)) GO TO 50                                         PRS    33
C                                                                           PRS    34
C       COMPRESSION                                                         PRS    35
C                                                                           PRS    36
   30 PRSC = (APL(MAT)+EX)*E*R+(APB(MAT)+BPB(MAT)*MU)*MU                    PRS    37
      IF (MIN) PRSC = AMAX1(PRSC,PMIN(MAT))                                 PRS    38
      IF (.NOT.PDER) GO TO 40                                               PRS    39
      PRC = (APL(MAT)+EX)*E+(APB(MAT)+2.0*BPB(MAT)*MU)/RHOZRO(MAT)+2.0*(PRS    40
     1E+EX/ETA)**2/(EZERO(MAT)*BPL(MAT))                                    PRS    41
      PEC = (APL(MAT)+EX-E+(EX/ETA)**2/(EZERO(MAT)*BPL(MAT)))*R             PRS    42
   40 IF (ETA.LT.1.0.AND.E.GT.ES(MAT)) GO TO 50                             PRS    43
      PRS = PRSC/RHOZRO(MAT)                                                PRS    44
      IF (.NOT.PDER) RETURN                                                 PRS    45
      PR = PRC                                                              PRS    46
      PE = PEC/RHOZRO(MAT)                                                  PRS    47
      RETURN                                                                PRS    48
   50 EY = EXP(-ALPH(MAT)*(MU/ETA)**2)                                      PRS    49
      EZ = EXP(BETA(MAT)*MU/ETA)                                            PRS    50
      PRSE = APL(MAT)*E*R+(E*R+EX+APB(MAT)*MU+F7)*EY                        PRS    51
      IF (MIN) PRSE = AMAX1(PRSE,PMIN(MAT))                                 PRS    52
      IF (.NOT.PDER) GO TO 60                                               PRS    53
      PRE = APL(MAT)+E+((E+R+EX+APB(MAT)+MU+EZ)+2.0+ALPH(MAT)+MU/(R+ETA+PRS    54
     1*2)+E+EX+2.0*(E+EX/ETA)**2/(EZERO(MAT)+BPL(MAT))+(APB(MAT)/RHOZRO(PRS    55
     2MAT)+APB(MAT)+MU+BETA(MAT)/(ETA+R))+EZ)+EY                            PRS    56
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      PEE = (APL(MAT)+(EX*E*(EX/ETA)**2/(EZERO(MAT)*BPL(MAT)))*EY)*R      PRS   57
   60 IF (E.LT.ESPRM(MAT)) GO TO 70                                       PRS   58
      PRS = PRSE/RHOZRO(MAT)                                              PRS   59
      IF (.NOT.PDER) RETURN                                               PRS   60
      PR = PRE                                                            PRS   61
      PE = PEE/RHOZRO(MAT)                                                PRS   62
      RETURN                                                              PRS   63
   70 A = (E-ES(MAT))/(ESPRM(MAT)-ES(MAT))                                PRS   64
      B = (ESPRM(MAT)-E)/(ESPRM(MAT)-ES(MAT))                             PRS   65
      PRS = (A*PRSE+B*PRSC)/RHOZRO(MAT)                                   PRS   66
      IF (.NOT.PDER) RETURN                                               PRS   67
      PR = A*PRE+B*PRC                                                    PRS   68
      PE = (A*PEE+B*PEC)/RHOZRO(MAT)                                      PRS   69
      RETURN                                                              PRS   70
      END                                                                 PRS   71
```